The Scenic Treasure House of Oregon

by WARREN D. SMITH

THE
SCENIC TREASURE-HOUSE
OF
OREGON

A well-know geologist who sees the color, feels the drama, catches the fascination of this far western state. He takes you on a field trip by sea, mountain, desert, and river.

In week-end travels, in longer journeyings, or even as you remain by your own fireside, the book can make you an adventurer up and down and across ninety-six thousand square miles of scenic treasures that make Oregon world famous.

In the volume is real adventure. In it is complete escape. Vulcanism . . . glaciation . . . erosion — these since the far beginning have been the three silent architects ceaselessly designing the *Scenic Treasure House of Oregon.* Warren D. Smith, knowing the magic and majesty they have worked, knowing them as a scientist and as a sensitive traveler, interprets them simply, fully, vividly.

(*Continued on back flap*)

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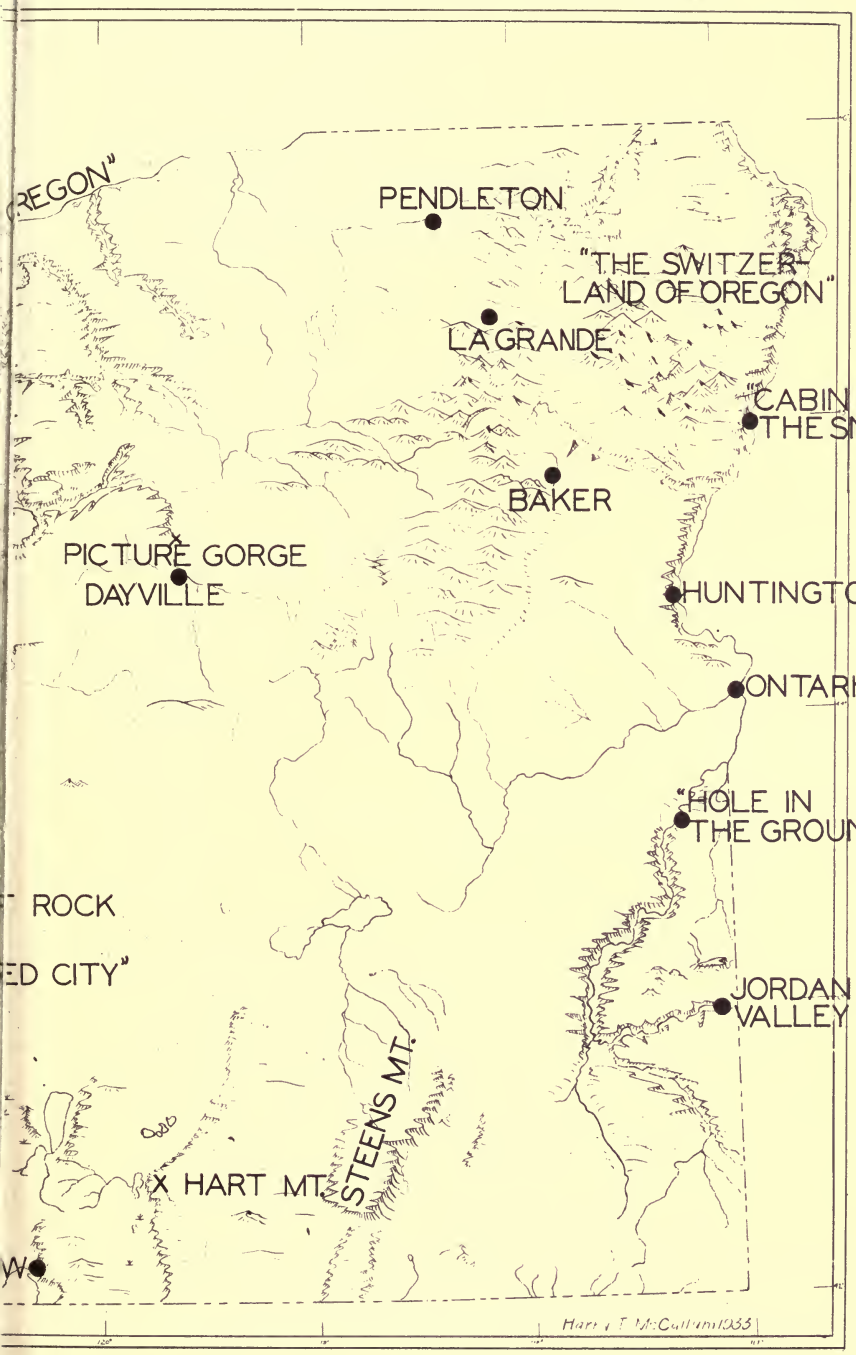

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The Scenic Treasure House of Oregon

BY

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BLOCKPRINTS BY NOLAN B. ZANE

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TO

PHOEBE ELLISON SMITH

IN MEMORY OF

BEACHFIRES AND CAMPS

ON THE LONG TRAIL

CONTENTS

	PAGE
THE APPRECIATION OF SCENERY	11
THE GEOLOGIC FRAMEWORK OF OREGON	25
OUTSTANDING GEOLOGICAL AND SCENIC FEATURES OF OREGON	32
THE COUNTRY WHERE DWELL THE THREE SISTERS	37
THE GHOST FOREST IN CLEAR LAKE	45
THE STORY OF MT. MAZAMA	49
"WHERE ROLLS THE OREGON"	58
"WY-EAST—THE MOUNTAIN"	67
THE OREGON COAST	71
GEOLOGICAL RAMBLES ABOUT NEWPORT ON THE OREGON COAST	83
ON THE ROAD TO "BANDON-BY-THE-SEA"	90
THROUGH THE ROGUE RIVER CANYON WITH A KNAPSACK	96
THE OREGON CAVES	102
KLAMATH LAKE	110
HART MOUNTAIN AND THE ANNUAL ANTELOPE ROUNDUP	114
THE COUNTRY THAT OREGON AND GOD FORGOT	118

CONTENTS—*Continued*

	PAGE
THE BURIED CITY OF THORN LAKE	129
THROUGH THE PICTURE GORGE TO THE ANCIENT LAIR OF THE OREODONTS	134
THE HOLE-IN-THE-GROUND AND WHAT BECAME OF IT	140
"THE SWITZERLAND OF OREGON"	143
A CABIN ON THE SNAKE	150
WILLAMETTE VALLEY SCENE	157
HINTS TO TRAVELERS	163
OUT-OF-DOORS ORGANIZATIONS IN OREGON	166
APPENDICES	171

FOREWORD

EDUCATION begins in wonder, and even the simplest description of Oregon's scenic investiture amazes the reader and stirs in him an age-old desire to follow the course of the sun to the romantic Pacific Northwest, the "Land of the Empire Builders", the last and perhaps the most challenging objective of migratory America.

The author of this book is no casual observer, no ordinary chronicler. He is, paradoxically, both a scientist and a romanticist, with a poetic appreciation of the beauty and grandeur of the great outdoors, and a special knowledge of the geological and historical facts, the Indian legendary lore of this vast and noble land, which enhances immeasurably our understanding and enjoyment of the mountains whose mighty arms have cradled glaciers for thousands of years, and of the sea, the ancient mother of us all.

Gladly we accept the guidance of this distinguished and sympathetic exponent of the outdoor life as we go venturing into the wilderness areas of the Oregon country—sanctuaries of wild life, wild beauty, wild flowers and wild waters—like fugitives seeking escape from the cluttering conveniences of civilization, the debasements of the city's dirt and noise. We shall hear the thunder of an avalanche, the leaden rhythm of the sea, the shouting of a glacial stream echoing in its sunless canyon, the bright laughter of a waterfall. And, circled about our evening campfire (which actually, dear reader, is your own library fire-place) we shall listen wonderingly to the stories of

vulcanism, glaciation, and erosion which invest our landscape with a strange enchantment, and be grateful for the companionship, the infectious enthusiasm and the never-pedantic erudition of Warren D. Smith.

FRANK BRANCH RILEY.

PREFACE

FOR a score of years the writer has been studying and teaching students and others some things about the natural resources of Oregon and he has finally come to believe that scenery is the major resource of this northwest country.

In the opening chapter he discusses the appreciation of scenery and in later pages lets the reader look at some of the best of Oregon scenes through the eyes of a geologist and physical geographer.

First, he wishes to acknowledge his indebtedness to several colleagues at the University of Oregon with whom he has discussed these matters both in the office and in the field. One of these is an artist, N. B. Zane, Professor of Art; another is a poet, E. G. Moll, Professor of English; and the third Ralph Leighton, Dean of the School of Physical Education of the University of Oregon, and greatly interested in recreation. Many of the ideas expressed in Chapter I. come as a result of our concerted research work a few years ago at Crater Lake, which was sponsored by the Carnegie Institution at Washington. Partly as a result of this work and partly as a result of his own experience as Ranger Naturalist at Crater Lake National Park, the writer is convinced that there is need for a great deal more education on the part of the general public along these lines. Some of this can be done in connection with the State and National Parks. In fact, he is convinced that one of the most important phases of adult education today in the whole country is that being carried on by the great National Parks.

The need for some education along these lines is illustrated by the story told recently of a woman who stood in Sinnott Memorial and, after looking at the magnificent spectacle before her of Crater Lake, had nothing more to say than the following: "Well, all I want to say is, this *is some* United States." She might better have said nothing than to have uttered this inane remark.

Following a general discussion of the appreciation of scenery, there is a chapter on the geological framework of the state. This is paramount to a real understanding of our scenery. The remaining chapters describe selected scenic areas of the state, so chosen that each great physiographic province is represented.

The last chapters tell something about the various organizations and agencies in this state promoting a love of the out-doors, with a few hints to prospective travellers in the Oregon Country.

The author is also greatly indebted to Mrs. Ada Hedges, of Binfords and Mort, and Mrs. James Stovall for much editorial assistance. As the latter is quite familiar with many of the features described, her critical comments and suggestions have proved invaluable.

"The hills are shadows, and they flow
From form to form, and nothing stands;
They melt like mist, the solid lands,
Like clouds they shape themselves and go."

THE SCENIC TREASURE HOUSE OF OREGON

Chapter I.

THE APPRECIATION OF SCENERY

NOW that the American public is definitely on the go, each day coming into contact with matchless scenery along our highways and in our national and state parks, more stress than ever before should be placed upon the elements and factors that enter into a true appreciation of scenery. In his travelogue, "From Sea to Sea", Kipling tells about his visit to the falls of the Yellowstone. The great writer stood before the magnificent spectacle and did not attempt to coin his feelings into words, but beside him at the time were a Chicago business man and a young girl. The business man, seeing the whole thing from a highly commercialized point of view, said, "Say, what a lot of water power is going to waste—" The girl giggled and said "My! ain't it cute?" Undoubtedly Kipling was experiencing an emotional enjoyment that was denied the other two because of their lack of knowledge of the fundamental prerequisites that are essential if one is to get the most out of this particular source of pleasure. Therefore in this chapter the author proposes to analyze this subject and emphasize the antecedent conditions which enter into a true appreciation of scenery.

First of all, if one is to realize a pure enjoyment of nature, the mind should be purged as far as possible of all extraneous matter such as bridge, drink, sex, or worries of any kind, for each of these in its own way hampers an exercise of this kind.

Second, one should be readily susceptible to the purely emotional, and should not be loth to express his feelings of delight. Many people have a mistaken notion that sentiment is something that belongs peculiarly to the weak. On the other hand, some of the finest expressions of tenderness and appreciation have come from the lips and pens of men who physically belong to the "he-man" type. It is told of Major Powell, the intrepid explorer of the Grand Canyon, that he hoped he would be remembered for the verse he wrote describing the tremendous nature pictures he had seen. Some of the tenderest poetry has been written by men who, on the proper occasions, can swear like sea-captains.

Next, in order fully to understand nature, one should have some knowledge of the forces, processes, and materials operating in Nature. This is the intellectual part of the complex process involved in our subject. How can one appreciate the manifold profiles in the landscape if he doesn't have any inkling of the causes that produced them. One looks at a *col* between two great peaks and may notice a beautiful parabolic curve, but how much more interesting would this be to him if he understood that this particular line is produced by the intersecting of two glacial cirques*. Also one should appreciate the fact that plants, animals, and man all operate to produce changes in the landscape and, oftentimes, to mar them.

Still another paramount factor is that of time. If one is in a hurry, he cannot properly enjoy, much less understand, Nature. It is not enough to pause for a moment beside the road and take a fleeting look and then jump in the car and speed on to the next stop. A person who is merely on his way in order to arrive somewhere and then

---

*Cirque: An amphitheater at the head of a glacial valley.

OREGON SCIENTISTS EXCAVATING IN DRY BED OF LOWER KLAMATH LAKE. MT. SHASTA IN THE DISTANCE

HECETA HEAD LIGHT HOUSE

State Hgw. Dept.

boast about how many miles he clocked off during the day may be a good driver but a poor observer.

At this point a story comes to mind of two travelling men who drove into Yellowstone Park and stopped in front of Old Faithful. Inquiring of the ranger when the next eruption would occur, and, being told it would be nearly half an hour, started to pull out, saying that they couldn't waste that much time, because they had to get to Chicago.

"Wait a while, my friends, you're not going to leave until you see this."

Of course the ranger had no authority to do this, but he took a chance and held up the protesting men. In due time Old Faithful "did his stuff", and the men were so thrilled they remained the rest of the day and couldn't get enough of this great spectacle. And likewise at Crater Lake, so many people take one look at the lake, then catch a glimpse of the squirrels and chipmunks, and never go down to the water or climb the nearby peaks, and for them Crater Lake is just another place they have visited but have not really seen. Most good things in life must be searched for and toiled over. For those who can afford the time, we advise getting off the road, even off some of the trails (but don't let the ranger catch you doing the latter—regulations, you know!)

Although a great deal of our knowledge of the outside world is attained through the senses—sight, hearing, feel, taste, and smell—if we are to get an entirely correct idea of the physical world there must be at work rather complex intellectual processes and, of course, a background of principles and observations under varying conditions.

How, you may ask, does hearing come into our discussion? Suppose we go into the mountains. There are about us lordly evergreen sentinels. Perhaps at our feet

is a glacier-born stream, wild and white and cold. Would we not lose half the enjoyment of these scenes if we could not hear the wind in the pines reminding us of the impatient rush of a great river; or if we could not catch the rippling sound of the stream as it disappears like a fugitive beneath the banks of moss, or the music of the cicadas in the jungle?

And how about touch? One of the things we like to do on our boat trip on Crater Lake is to land the party at the base of the "Devil's backbone"—a huge dike in the crater wall. We ask each to place a hand on this massive structure. He finds its surface hard and rough and thus gets an additional and different conception from the one gained by looking at it from a distance.

This matter of touch is so important that the person who is expertly trained to judge and handle precious stones can distinguish between these and worthless ones even when blindfolded. In fact, many rocks and minerals may be identified by the "feel" of them.

In what possible way may taste be of use in helping us to enjoy scenery? We look down upon Alkali Lake in central Oregon. At a distance it appears to be snow-covered, but when we approach it and taste the white deposit, we find to our surprise that it is soda. At once our thoughts are shifted from a scene of frozen water to the rancher's kitchen and a pan of hot biscuits. Or perhaps we recall a visit to some chemical works with its vats and solutions, or if our knowledge of soda is wide, our thoughts take us to the sodium nitrate deposits on the high pampa of northern Chile.

And now for the sense of smell. Out in China the old timers speak not of seeing China, but of "smelling China". It is true it is not so pleasant as seeing the country, but

one who has lost his sense of smell would never really know China.

Conrad has perhaps given us the best short picture of the East when he tells about his first contact with it and getting not only a vivid picture of an island in the Far East but also the complex aroma that one experiences only in that part of the world. The present writer vividly recalls a mixture of fetid, pungent, and acrid odors typical of Malay villages which one has to experience to realize what they are. Of course, we who have gone to sea know what the smell of the sea means and how we delight in it. Jungles and deserts and mountains and verdant dells all have their distinctive odors which help us to enjoy them.

Now we come to the more intellectual processes and how they aid us in our enjoyment of scenery. It is true we can get much fine enjoyment from a landscape by simply *feeling* it in a purely emotional way, but to enjoy it thoroughly we must understand what we are looking at.

Since our physical world, the stage we all not only look at but play out all our existence on, is made up of minerals, rocks, water, trees, and animals, we ought at least to have an elementary knowledge of the earth materials, their structures and textures and the processes of Nature which have produced them and sculptured them. We shall not have much to say about the plants and animals in this chapter, but concentrate on the geological aspects of this subject.

Although the lowly minerals play individually an important role in Nature, we generally see them *en masse* in the rocks. Their chief interest for us here lies in the fact that they impart the particular colors and textures that please us when we look at the rocks and cliffs.

Passing on to the rocks we learn that some rocks, like sandstones, are sediments, water-laid or wind-laid. Others,

like lavas, are igneous (or fire-born) and still others, like slate, belong to a totally different group known to the geologists as metamorphic, in which the form, and even to a certain extent the mineral content, has been changed. Each of these groups has its peculiar structures and textures which profoundly influence the resulting sculpturing done by water, ice, and wind.

Compare, for instance, the scenery of our Oregon coast with that of the high cascades. Everyone knows that the two regions are utterly different, and most people "let it go at that", but in what ways do these differences arise? The waves of the ocean pounding away on the sandstone or shale formations of the Oregon coast will produce one type of scenery, while the streams and glaciers in the mountains will produce totally different effects, and when we go into the semi-arid portions of the state still other results are seen.

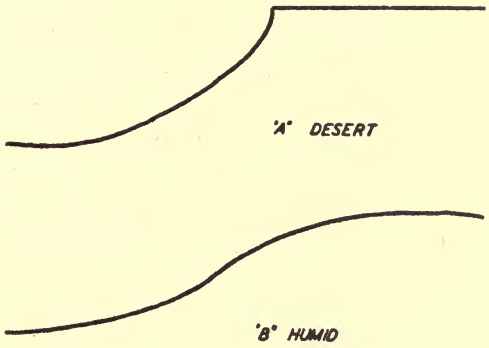
One of the most characteristic features in the landscape is the profile or silhouette. We speak of these as character profiles, and we get to know them just as we learn to know the familiar profile of a friend. And so we have character profiles of the coast, of the desert, of the mountains, of low, humid regions, etc. Just a few examples to bring this home to you:

A bold headland on the coast usually means hard igneous rock, whereas the gentler curves and sweeping lines indicate softer rocks. If the headland is terraced, i.e., has a step-like profile, it points to still-stands of the coast interrupted by elevation.

A U-shaped valley cross-section in the mountains, or the coast for that matter, generally means one thing, glaciation.

A fretted pinnacle generally has been produced by the work of the wind in an arid region.

A long concave slope is typical of arid regions where a hard lava capping of rock overlies softer rocks, while a convex slope indicates a humid climate and softer rocks. These two lines are shown in Figure I.



(A) Desert Profile (B) Humid Profile

The line in (B) is also known as "Hogarth's line of beauty".

Another important thing to consider is the "stage" of development of topography. All land forms go through an evolution, stages from early youth, through maturity to old age.

For example, a volcano may in extreme youth be, and will have, if it is made up dominantly of fragmental material, a cone shape. Later, if glaciers are at work on it, it will become a pyramid, later on a horn, and finally it will be reduced to a low, rather featureless hump. Rivers go through similar stages of development as follows: gully, canyon (where the rocks are hard and greatly fissured), wide valley with moderately steep slopes, and finally a broad nearly flat-bottom depression with very gentle

sides, until a peneplain (or almost-plain) is reached, which marks its old age stage.

The principal geologic processes are: the work of running water, the work of the waves and currents, glaciation, vulcanism, and movements of the crust of the earth. All these processes work individually and collectively either to build up or tear down the land.

And here we are brought sharply up against one important thing—change, continual, unceasing, remorseless change—nothing is fixed in the landscape. The Psalmist of old spoke of the "everlasting hills". There are no such hills.

Furthermore, if we would study these processes and would understand what has gone on in the past we must study them as they operate today. "The Key to the Past is the Present." This is the well-known (to geologists) doctrine of uniformitarianism, which must not be confused with Unitarianism, which is a different thing altogether.

This subject of the part that geology plays in scenery could be elaborated into such a long discussion that it would soon have the proportions of a book, but if the reader wants to know more about this great subject, he is recommended to read and study Sir Archibald Geikie's classic "The Scenery of Scotland" or Shaler's "Land and Sea" or a more modern treatise by Hobbs entitled "Earth Features and Their Meaning".

Before bringing this to a close, we must discuss one other aspect of the subject which is of paramount importance to us today. The geological work of man is not a new theme, but an oft ignored one, and today we can no longer pass it lightly. Not only does man protect scenery in many places, as in the great National Parks and Monuments, but he also destroys it or defaces it.

One of the ways in which man changes and mars the

landscape most effectively is in the removal of the forest cover, allowing streams to slash and gouge the hill and mountain sides, stripping the soil and promoting the flooding of the lowlands. Happily, this insensate waste and ruthless despoiliation is being checked. In some parts of the world, notably China, it is too late; the damage is done and perhaps can never be repaired. In our own states, many hundreds of thousands of acres have been ruined and the great rivers of the Middle West are completing the destruction. Here in Oregon, with our matchless forests—one-fourth of the total for the entire nation—and marvelous scenery, we have decided upon a course of conservation of both our timber and our scenic resources and soon this state will be the playground of America.

Scenery will in time become our greatest natural resource. Men who believe in the doctrine of laissez-faire and rugged individualism to the extent that they become callous to our wishes in the preservation of our forests are coming in for some rough treatment in the days to come if they persist in such policies of exploitation.

And now by way of closing and getting back to a higher level in our discussion—why do we want to know in order to appreciate? Just a few words need be said here on this theme. The artist sees certain things in a picture—line, pattern, color, and so forth—and they are important. The scientist sees certain other features and they are no less important; the poet sees still other things and lets his imagination supply the rest. Of old it has been said by those who have not thought these things through, or have had schooling in not more than one discipline, that the artist and the scientist are antagonistic. On the contrary, they complement each other, and only he who has either knowledge of or appreciation for the work of both is capable of getting the most out of his experience with scenery.

Neither the artist nor the scientist can afford to scoff at the other's efforts, and it is only the pseudo-artist or pseudo-scientist who would think of doing so.

Furthermore, true appreciation of scenery will go a long way toward helping people maintain their interest in life and a proper mental balance. In fact, next to a clear conscience, this writer knows of no better therapeutic for many of the ills resulting from our hectic modern life.

> "These beauteous forms through a long absence, have not
> been to me as is a landscape to a blind man's eye;
> "But oft in lonely rooms, mid the din of towns and cities
> I have owed to them in hours of weariness sensations
> "Sweet, felt in the Blood, and felt along the heart,
> And passing even into my purer mind, with tranquil
> restoration:" . . . .
>
> WORDSWORTH—*Tinturn Abbey.*

The following quotations are a few excerpts from the writings of John Muir, the prose poet of the Sierras, which will reveal to the reader the richness of the experiences of one who combined the aesthetic with the scientific appreciation of the landscape:

Extracts from "Mountains of California" by John Muir.

"The eye, rejoicing in its freedom, roves about the vast expanse, yet returns again and again to the mountain peaks. Perhaps some one of the multitude excites special attention, some gigantic castle with turret and battlement, or some Gothic cathedral more abundantly spired than Milan's. But generally, when looking for the first time from an all-embracing standpoint like this, the inexperienced observer is oppressed by the incomprehensible grandeur, variety, and abundance of the mountains rising shoulder to shoulder beyond the reach of vision; and it is only after they have been studied one by one, long and

lovingly, that their far-reaching harmonies become mani fest. Then, penetrate the wilderness where you may, the main telling features, to which all the surrounding topography is subordinate, are quickly perceived, and the most complicated clusters of peaks stand revealed harmoniously correlated and fashioned like works of art—eloquent monuments of the ancient ice-rivers that brought them into relief from the general mass of the range. The canyons, too, some of them a mile deep, mazing wildly through the mighty host of mountains, however lawless and ungovernable at the first sight they appear, are at length recognized as the necessary effects of causes which followed each other in harmonious sequence—Nature's poems carved on the tables of stone—the simplest and most emphatic of her glacial compositions.

"Could we have been here to observe during the glacial period we should have overlooked a wrinkled ocean of ice as continuous as that now covering the landscapes of Greenland; filling every valley and canyon with only the tops of the mountain peaks rising darkly above the rock-encumbered ice-waves like islets in a stormy sea—those islets the only hints of the glorious landscapes now smiling in the sun. Standing here in the deep, brooding silence, all the wilderness seems motionless, as if the work of creation were done. But in the midst of this outer steadfastness we know there is incessant motion and change. Ever and anon, avalanches are falling from yonder peaks. These cliff-bound glaciers, seemingly wedges and immovable, are flowing like water and grinding the rocks beneath them. The lakes are lapping their granite shores and wearing them away, and every one of these rills and young rivers is fretting the air into music, and carrying the mountains to the plains. Here are the roots of all the life of the valleys, and here more simply than elsewhere is the eternal flux of

nature manifested. Ice changing to water, lakes to meadows, and mountains to plains. And while we thus contemplate Nature's methods of landscape creation, and reading the records she has carved on the rocks, reconstruct, however imperfectly, the landscapes of the past, we also learn that as these we now behold have succeeded those of the glacial age, so they in turn are withering and vanishing to be succeeded by others yet unborn.

"Most people like to look at mountain rivers, and bear them in mind, but few care to look at the winds, though far more beautiful and sublime, and though they become at times about as visible as flowing water. When the north winds in winter are making upward sweeps over the curving summits of the High Sierra, the fact is sometimes published with flying snow-banners a mile long. Those portions of the winds thus embodied can scarce be wholly invisible, even to the darkest imagination. And when we look around over an agitated forest, we may see something of the wind that stirs it, by its effects upon the trees. Yonder it descends in a rush of water-like ripples, and sweeps over the bending pines from hill to hill. Nearer, we see detached plumes and leaves, now speeding by on level currents, now whirling in eddies, or, escaping over the edges of the whirls, scaring aloft on grand, upswelling domes of air, or tossing on flame-like crests. Smooth, deep currents, cascades, falls, and swirling eddies, sing around every tree and leaf, and over all the varied topography of the region with telling changes of form, like mountain rivers conforming to the features of their channels.

"After tracing the Sierra streams from their fountains to the plains, marking where they bloom white in falls, glide in crystal plumes, surge gray and foam-filled in boulder-choked gorges, and slip through the woods in long, tranquil reaches—after thus learning their language

and forms in detail, we may at length hear them chanting all together in one grand anthem, and comprehend them all in clear vision, covering the range with lace. But even this spectacle is far less sublime and not a whit more substantial than that we may behold of these storm-streams of air in the mountain woods.

"We all travel the Milky Way together, trees and men; but it never occurred to me until this storm-day, while swinging in the wind, that trees are travelers, in the ordinary sense. They make many journeys, not extensive ones, it is true; but our own little journeys, away and back again, are only little more than tree wavings—many of them not so much."

And now by way of closing we should like to make an observation or two concerning the effect of scenery on man.

Although a few sadistically inclined persons have a perverted desire to mar everything beautiful they see (evincing an insane wish to destroy whatever seems to run counter to their own ugly and misshaped thoughts) the bulk of mankind responds to beauty.

There appear to be at least two especial types of responses: one is attachment for accustomed scenes and the other is inspiration from and wonder at new scenes of grandeur and beauty, such as the sea, mountains, and deserts.

Now the first of these is something like the feelings of attachment to the home and aesthetics may have little part to play. Even a cat shows this sort of response. We recall here, as a case in point, the story of the old woman of Shantytown in a northern Wisconsin waste land, left particularly desolate by the ruthless lumber baron. She had just returned from a trip to New York and saw nothing, so she said, that equalled Shantytown. She was perfectly satisfied.

But when it comes to the other kind of feeling, we have something quite different, maybe not any more important for the race but certainly of a different order. There can be but a few unfortunate ones who have not experienced at some time or other in their lives the peculiar thrills one gets from contemplating beautiful scenery. Think of all the songs, poems and even books, whose authors have been inspired by the great pictures in Nature. How impoverished our literature, all literatures would be without them: "and is there a man with soul so dead" who will deny the elevating influence of such scenes and occasions? Only the sourest cynic would think of doing so. If there be such, unfortunately, reading these lines, let him go up onto a high mount and overlook the sea, gaze upon the colors of the Grand Canyon, or face the cataract of Niagara—if he is not stirred with elevated thoughts, *then* indeed is he a sick man and needs to worry.

Chapter II.

THE GEOLOGIC FRAMEWORK OF OREGON

IN VIEW of the many considerations covered in the preceeding chapter, we shall in this one give a brief sketch of the geological "set-up" of our state in order that the reader may have a clearer picture of the basal materials out of which the physiographic pattern, and especially our scenery, has been carved by Nature's great sculpturing tools.

It must be understood at the beginning that the State of Oregon is a part of the great natural region, the Pacific Northwest, most of which was formerly known as the Oregon Country.* It is a region, much of which is relatively young both geologically and politically. Geologically much of it dates from the Tertiary Period, and politically it is less than one century old.

The next outstanding thing to note with reference to this region is that the great mountain range, the Cascades, a chain of volcanic peaks, runs north and south through it. This volcanic chain divides Oregon (as well as Washington) into a one-third marine western portion and a two-third continental eastern portion, and is directly responsible for very striking and far-reaching climatic differences.

The principal larger formation groupings are ten in number as follows:

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*This sounds like a perfectly obvious statement, but, unfortunately, too many of our countrymen do not know their geography.

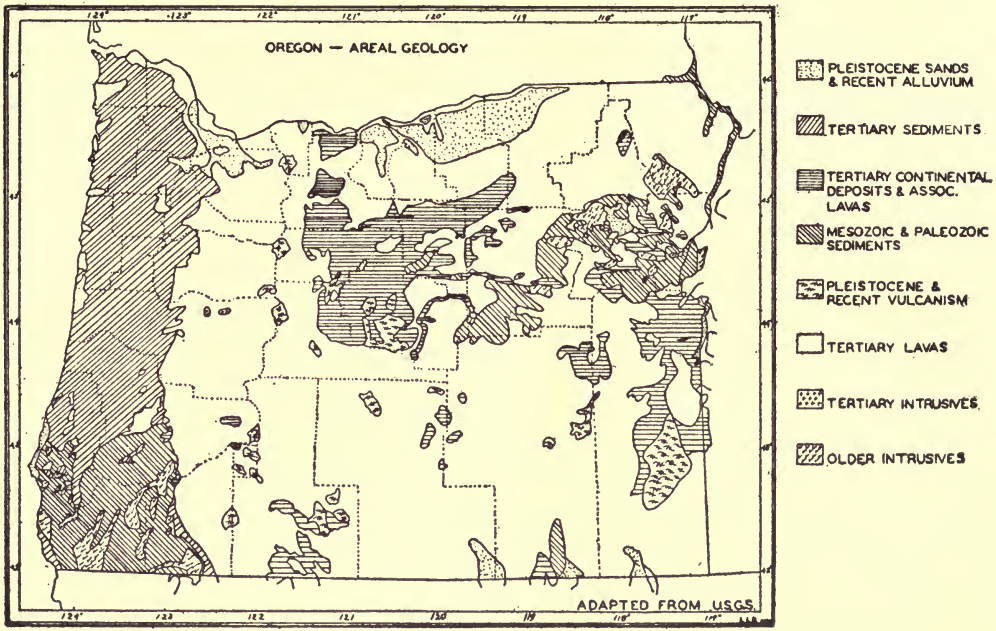
(1) Two great batholiths (deep-seated rocks) of intrusive granite-like rocks, flanked by older rocks profoundly changed from their original condition through the complicated physical and chemical processes operating through long periods of time. These two areas of older rocks suggested to Dr. Condon the idea of the "Two Islands." One of these "Islands" was in northeastern Oregon, and was named Shoshone; the other, in the southwestern part of the state, was named Siskiyou. This ancient land mass of Shoshone is the nucleus of the present Blue Mountains, while Siskiyou is the nucleus of the present Klamath Mountains of southwestern Oregon and northern California. Ashland "granite" is a representative of this deep-seated (batholith) formation.

(2) A complex mass of still older Paleozoic sediments and ancient lavas some of which go back to the very morning of time in Oregon. A conspicuous formation in this group is that generally referred to as "greenstone", a name which often covers more than one kind of rock. Some of these "greenstones" are much altered old lavas. Greenstones are found typically in Jackson and Josephine Counties and in northeastern Oregon.

(3) Marbles, argillites, etc., Paleozoic and Mesozoic metamorphic rocks referred to above as flanking the granite intrusions. It is noteworthy that practically all the limestone of the state is now in the form of marble. The marble of the Oregon Caves is a sample of this group. The argillites are slaty rocks which were originally shales or muds.

(4) Mesozoic sandstones and shales—old, but not having suffered much alteration. Sandstones and shales near Mitchell in eastern Oregon illustrate this group.

(5) Tertiary sediments, principally sandstones and shales, comprising much of the Coast Range and underlying the Willamette Valley. These are generally less


OREGON — AREAL GEOLOGY
PLEISTOCENE SANDS & RECENT ALLUVIUM
TERTIARY SEDIMENTS
TERTIARY CONTINENTAL DEPOSITS & ASSOC. LAVAS
MESOZOIC & PALEOZOIC SEDIMENTS
PLEISTOCENE & RECENT VULCANISM
TERTIARY LAVAS
TERTIARY INTRUSIVES
OLDER INTRUSIVES
ADAPTED FROM U.S.G.S.

consolidated and less altered than others of Mesozoic age.

(6) Tertiary lavas—basalt and andesite flows, with which are intercalated great beds of volcanic fragments, the result of explosive eruptions. These comprise the Cascades and much of the plateau region of eastern Oregon. Typical basalt is found in the Columbia Gorge and andesites near the summit of the Cascades.

(7) Glacial moraines in the higher mountains, chiefly deposits of loose unsorted rock fragments and sand. Abundant in Wallowa Mountains and the High Cascades.

(8) Pliocene and pleistocene lake deposits—diatomite, near Terrebonne on Deschutes river.

(9) Alluvial filling in the valley bottoms. This is very thick and important in some parts of the Willamette Valley.

(10) Recent lava flows in the high Cascades, McKenzie Pass, etc. The general distribution of these is shown on the sketch map adapted from the general geological map of the United States compiled some years ago (with our help) by the U. S. Geological Survey.

In general we may say that the present state has developed about the two nuclei, or "islands" of Condon, by successive accretions of later formations, marine in the western portion, chiefly terrestrial and continental deposits in the eastern.

In bare outline the geological history has been about as follows:

The events of the very early periods are still shrouded in more or less mystery.

In the Paleozoic, or ancient life era, there may have been extensive land masses with mountain ranges, but the extent and height of these is more or less conjectural.

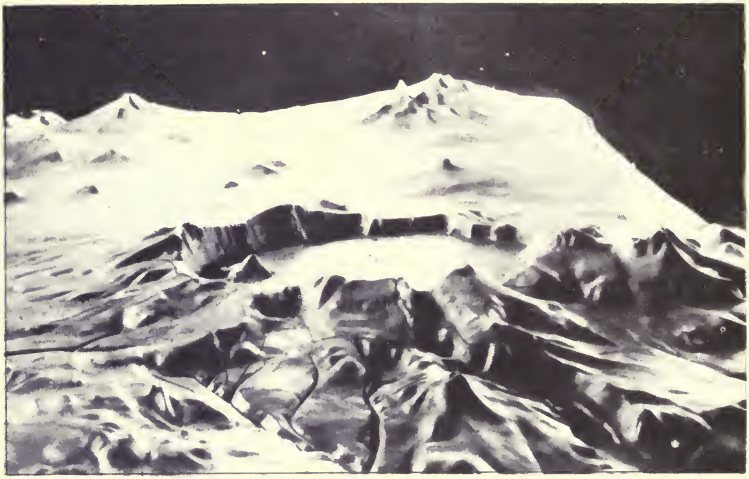
In the Mesozoic, or Middle Ages of the geological record, there were mountain ranges in Central Oregon

NORTH SISTER AND OBSERVATORY, McKENZIE PASS

State Hgw. Dept.

COLLIER GLACIER FROM SUMMIT OF NORTH SISTER

Thomas Miles



MODEL OF CRATER LAKE

Park Service

SUN NOTCH — CRATER LAKE

where now Tertiary lavas cover most of the country. Glimpses of these old mountains can be had through so-called geological "windows" as in the Suplee Country northwest of Burns.

In the Post-Jurassic, or Middle Mesozoic occurred the great granitic intrusions of northeastern and southwestern Oregon which elevated the nuclei or "two islands" already referred to. The principal metalliferous veins of the state were formed at that time as a result of mineral bearing solutions emanating from these deep-seated igneous rocks.

In the late Mesozoic an extensive transgression of the sea across the great area of Oregon, at least as far as Central Oregon, occurred and extensive sandstone and shale deposits were laid down. These were folded and faulted in the Laramide Revolution of mountain making (Rocky Mountains). Many of these sediments were altered into slates and marbles.

At the beginning of the Tertiary, in the Dawn of the Recent, or Eocene, began a long continued elevation of the Oregon Country accompanied by outpouring of lavas, reaching its culmination in the Miocene. Both profound folding and faulting also occurred, resulting in the elevation, folding, faulting, and lava accumulation of the Cascade mountain barrier and the Coast Range. The outpouring of lava continued until recent times and extended far across the Oregon Country into what is now the state of Idaho.

During the Oligocene and before the Cascade barrier had been raised to any appreciable height, there were extensive sub-tropical forests over much of the Oregon Country with Sequoias and other trees flourishing which are not found here at present. Due to the elevation of this mountain wall, and other causes, perhaps of a planetary nature, the climate became much cooler.

In the Pleistocene, as in other parts of northern North America extensive Alpine glaciers were formed extending many times farther down the valleys than they do today. At the close of the Pleistocene there were extensive lakes in eastern Oregon, at least 200 feet deeper than they are today.

It was toward the close of the Pleistocene that a gigantic explosion* of Krakatoan magnitude wrecked ancient Mt. Mazama in the southern Cascades and Crater Lake was formed. Within the last thousand years both volcanic activity and glaciation have been on the wane.

Throughout this long geological history there have been periodic sinkings and elevations of the crust of the earth revealed along the coast which has made this history much more complicated and interesting, the details of which would be out of place in a treatise of this kind.

The topographic and hydrographic features to be described in the next chapters are the results of these geological agents; gradation (erosion and deposition), vulcanism, glaciation, and crustal movements involving the various formations enumerated in the foregoing paragraphs, operating through long periods. As some portions of the state are younger than others, the stage of development, whether youth, maturity or old age, is highly significant in the kind of landscape we have to deal with. In the production of a given topographic and hydrographic pattern of any region we have to consider three factors: (1) kind of rocks and their attitude, (2) geological processes at work and (3) stage of development.

There are four geological features, as a result of all this geological activity throughout the ages, which are of

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*The older, and by some geologists, preferred explanation, is through collapse and engulfment.

especial importance to man, particularly in Oregon. These are:

(1) Soil, the most valuable of all geological products

(2) Water, both surface and subsurface

(3) Minerals—iron, coal, copper, chromite, etc. On these our industrial life depends.

(4) Scenery—upon the manifold and remarkable variety of combinations of rocks and color depends much of our aesthetic and recreational life.

In closing this all too short outline of the geological framework of Oregon, let it be pointed out also that for any fundamental understanding of many of the state's economic problems, some knowledge of these basic facts is absolutely prerequisite. Upon the geological formations and structures depend our resources and conditions of living.

For more complete discussions of the geology of the state the reader's attention is called to some of the more important books and articles listed in Appendix A. For still further details on particular subjects, the reader should consult the Bibliography by Treasher and Hodge, issued by the State Planning Board (1936).

Chapter III.

OUTSTANDING GEOLOGICAL AND SCENIC FEATURES OF OREGON

THE State of Oregon is noteworthy for its many unique scenic features and for its great diversity of geological formations. Wherever geologists congregate something is apt to be said about the world-famous Crater Lake, the John Day Fossil beds, the Columbia Gorge, or the Columbia Lava Plateau. In the present volume, technical and detailed discussions of these outstanding geological features would be out of place. If the reader wishes this type of information he must go to the many geological publications of the United States Geological Survey, of the University of Oregon, and other organizations which have from time to time made special studies of this region.

Two general statements should be made before these features are enumerated. First of all, Oregon is a segment of the most active portion of the continent, where not only the world is still "in the making" but where from Alaska to Mexico, the most active geological work in the country is being carried on. Second, Oregon may be divided into two portions: western and eastern. The part west of the Cascade Range is *marine* and has affiliations with the east coast of Asia. The larger part of the state, however, east of the Cascade Mountains, is *continental* and strictly American, and the formations therein are dominantly terrestrial rather than marine. With these general statements, we

shall now enumerate, with a short word of comment, some of the outstanding geological features of our state.

1. *Crater Lake* is unique among all the crater lakes of the world and stands with the Grand Canyon of the Colorado and Victoria Falls in Africa, as one of the three greatest scenic features of our globe. Among geologists, the origin of Crater Lake is a subject of controversy. There are two schools of thought in the matter; those who believe that Crater Lake is due to the explosion and blowing off the head of a pre-historic mountain of greater proportions called Mt. Mazama, and those who believe it is a *caldera* due to the subsidence and foundering of this old mountain.

2. *The John Day Fossil Beds* rival the famous *Rancho La Brea* asphalt deposits within the City of Los Angeles as a tomb of prehistoric animals. Besides the unusual assemblage of vertebrate fossils, which were made known to the world from that area by the late Dr. Thomas Condon, the John Day geological section is one of utmost importance to the research student of Oregon Geology.

3. *The Columbia Gorge* has long been thought to be due, for the most part, to the erosion by the river as an *antecedent* stream cutting its way across the uprising folds of the Columbia River Lava that were slowly raised athwart its path. Recently geological work by members of the Department of Geology in the University indicates that its history is probably quite different and much more interesting. A cross-section of this remarkable river enables us to study one of the three largest lava plateaus on the globe. One of these is the Deccan in India, a second is that in East Africa, but of these three, perhaps our own Columbia Lava plateau of eastern Oregon, eastern Washington, and Western Idaho, is the most important.

4. *Wallowa Lake* is typical of certain glacial lakes found in other parts of the world, but nowhere has the

writer seen as fine an example as we have in this one of Oregon. It is due to the damming of a river gorge by the lateral and terminal moraines of a glacier which was at one time about seventeen miles in length, but which has now shrunk to less than one-fourth mile. The whole country surrounding this interesting lake is of great geological interest as well as of scenic beauty. It is in the heart of what is sometimes called the "Switzerland of Oregon."

5. *The Oregon Shore Line* offers us the finest north and south geological section of the State of Oregon. Here the processes going on in the atmosphere, hydrosphere, and lithosphere interact and sometimes with striking results. This section is easily accessible by way of the recently-constructed Oregon Coast Highway.

6. *Oregon Caves*, the so-called Marble Halls of Oregon, in the southwestern corner of the state, are a series of great caverns produced by the slow work of ground water working through the ages in immense limestone deposits. These are justly famous and appreciated by the serious student of geology as well as the tourist. Though not as large as some of the caverns of Virginia and Kentucky, they are perhaps the largest in the northwestern part of the United States.

7. *Steens, Warner, and Abert Mountains*, in central and southeastern Oregon, is a series of remarkable geological structures rivalling the great rift valley features of eastern Africa, in some ways more remarkable than the latter. These prominent features consisting of portions of folds and tilted fault blocks with escarpments five thousand feet in height with interesting desert features such as *playas*, borax lakes, etc., make these a group of geological features that amaze the tourist and have caused geologists to come from far and wide to study them.

8. In the *Deschutes River* we have what is considered

by engineers to be perhaps the finest power stream in the United States which owing to the nature of the materials through which it flows—porous lava and volcanic ash—shows an extremely small fluctuation in its flow throughout the year. This stream has been regarded as one of the great fishing streams of the state, but it is of much greater importance and interest as a power stream and because of its geological history.

9. *Mount Hood,* just south of the Columbia River, stands out among the lordly sentinels of the Cascade Range extending from Mount Lassen in California far north into Alaska, as one of the great mountains of the Pacific Northwest. Its geological history has been studied assiduously by members of the University of Oregon geological staff and has been found to be much more complicated than was previously thought. Both tourists and students find this mountain very accessible from Portland. The federal government has recently completed a magnificent mountain lodge known as Timberline Lodge on its south slope.

10. *The Three Sisters,* due east of Eugene at the summit of the Cascade mountains, form one of the most interesting regions geologically in the state. The present snow-capped mountains, over ten thousand feet in elevation, known as the Three Sisters, apparently are very young mountains which have grown up within the wreck of a formerly existing mountain of much greater proportions, to which Dr. E. T. Hodge, formerly of the University Department of Geology, has given the name of Mount Multnomah. If Hodge's theory be correct, this "ancient ancestor of the Three Sisters" was one of the largest volcanic peaks of the entire western cordillera of North America. The extensive lava flows of comparatively recent age just north of the State Highway, exhibit the phenomena of extensive vulcanism on a grand scale. These

are, perhaps, second only to those in Modoc Lava Beds National Monument in northern California.

11. *The Snake River and Hell's Canyon* is a remarkable gorge lying between the Wallowa Mountains and the Seven Devil's Range in Idaho. Without the bright colors of the Grand Canyon, but deeper and darker, indeed, most awesome, this great slash in the earth reveals a section several thousand feet deep through the entire Snake River Lava series down into the older rocks of the State.

12. *Multnomah Falls* is the highest and most famed of all the waterfalls of Oregon. It is located 32 miles east of Portland on the equally famed Columbia highway. The water drops 610 feet from basalt cliffs lining the Columbia Gorge.

13. *The Owyhee Box Canyon* is a very narrow canyon where the Owyhee River cuts through a rhyolite lava formation, whose course was probably largely determined by an extensive fracture, in eastern Malheur county. This canyon is now spanned by a dam 405 feet in height, the third highest in the world at present. The capacity of this reservoir is 232,983,000,000 gallons.

In brief, these are some of the outstanding geological features that have attracted the attention, not only of the geological world, but tourists from all over the globe and will, in the future, attract many more. Some of these are unique, but all of them are notable and their great range and variety, in the matter of geological structure and history, make them of tremendous interest, not only to students, but even to the most casual and blase of tourists. It is this assemblage of wonderful geological features, with many others hardly less interesting, that the geological students and the people of Oregon have at their very doors and easily accessible the year around.

Chapter IV.

THE COUNTRY WHERE DWELL THE THREE SISTERS*

IF THE reader were to come into a theater just after the actors had finished speaking their parts in a great tragedy, but before the curtain had fallen, he would know how I felt when I got close view of the Three Sisters for the first time. I had long seen them from a distance and they were cold, distant—they were more—they were remote. It has been my privilege to see volcanoes in action in Italy, in the Far East, and therefore I viewed the majestic Sisters with something akin to respect, almost of awe, wondering how long they had slept, how long they would be sleeping.

The Middle Sister looked comely and placid, and so I chose to place my offering upon her chaste white brow. The South Sister lived too far out in the country and the North Sister reminded me of Medusa of old with her wild snaky locks—death lurked there in each of those jagged points. Even as I looked at the Sister of my choice, a disquieting thought came to me—what if the majestic, but sleeping princess of the forest should wake from her hundred year's slumber! Many had wooed her and placed their offering upon her head, but might not one of us be the prince whose kiss would wake her? God

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*First published in *Mazama, Vol.* 5, *No.* 1. (1916).

forbid that she should awaken again in our time or at least while we are so close by! What an appalling spectacle those angry Sisters would make no one can adequately imagine who has not seen one of those furnaces in action. I once saw three Tagalog women haranguing one another on the street corner and the eruption of words (no dictograph could keep up with the steady flow) was volcanic, epithets were hurled forth, and streams of vituperation poured forth and overwhelmed all within hearing. Whenever I think of the *Three Sisters* and try to picture their turbulent past I am reminded of those three little brown sisters in far-off Luzon.

The dormant (I am not so sure that they are extinct) volcanoes of the Cascades are a part of that great ring of vents about the Pacific ocean known to geologists as the "Circle of Fire." We cannot exactly say how long since they were active (we do know that it has been only a few hundred years) nor how long before they may erupt again. To the south of us we see Lassen Peak in this same range, enjoying the reputation of being able to "come back"—to the north, in Alaska, are also signs of rejuvenescence. The writer knows full well the fate that overtakes all prophets, particularly those of the Cassandra class, and yet he ventures the prediction that "the worst is yet to come." When the next furnace will be "blown in" he does not care or attempt to guess. Supposing this be true, it need not be an unmixed evil. Volcanoes are spectacular; they sometimes cause no little inconvenience, as for instance the "late unpleasantness" at Pompeii—no doubt it upset quite a number of little dinner parties and spoiled the rugs. I have a picture in my collection by Le Roux depicting what might have been a very common incident during that eruption. It shows milady with her maidservants around her on an eminence overlooking the

stricken city. She is swooning into the arms of one of them, while others are hurrying up the slope, their arms laden with robes and trinkets. They really look quite flustered, and yet volcanoes are mere incidents in geological history and in the last analysis they have been beneficial rather than otherwise, for they doubtless afford a relief of heat and pressure in old Mother Earth which, if pent up too long, might cause more serious damage.

Some suggestions as to recent history of the Three Sisters region may not be without interest. As these can be conjectural only in the absence of detailed study, it is hoped the reader will not be too critical. From the apparent general positions and topographic relations of the various peaks in the cluster known as the "Sisters" and from the rate of erosion which has taken place, it would seem that the North Sister is but a remnant of a large rim, only a small arc of which remains, of a much larger volcano than any now in the region. The South and Middle Sisters then must be considered as later and subsidiary cones. The Middle Sister shows no crater now, only a sharp peak, but the South Sister has still a well-defined crater. These, then, bear perhaps the same relationship to the north member of the group that the present active cone of Vesuvius does to the old mountain of Monte Somma. A more appropriate name for the North Sister would be, in my opinion, the "Mother."

Furthermore, the nature of much of the eruptive material in this region is such as to lead one to conclude that while there has been outpouring of molten rock at times, much of the *ejecta* has been blown violently from the different vents. At least in their latter days these Sisters were turbulent. It may not be improbable that the oldest Sister (North) fell into such a rage that she had a brain storm and blew off her own head.

As for the Husband, who certainly looks "henpecked" to say the least, we venture the opinion that he too is fairly old. There was once a well-defined crater in this gentleman's august top which has been eaten sadly into on one side. This was probably done by a glacier. It is hard to tell from a distance whether the now prominent amphitheater on the east is due more to crater than to *cirque.*

This leads up to another point, namely the role played by these cirques in the resulting shapes of the peaks. Originally most of these mountains were cones and now many of them, particularly the older ones north of the Sisters, are pyramids. In Europe they would be called "horns." Now the horn is a result not of a building up, but of a tearing down process, and in this the glacial cirque has had the dominant part. If there be several glaciers emanating from a mountain (and this is often the case) there will be as many cirques or amphitheaters at their heads, and if these cirques be considered as approximating the form of so many truncated and inverted cones and gradually approaching one another through erosion so as ultimately to intersect them, we may look for interesting results. Going back to your conic sections you will recall that such intersections will produce parabolas and in Alpine Europe when there is a perfect forest of peaks and glaciers, the parabola-shaped skyline between peaks is common. These are known as *cols* and they leave almost invariably sharp pyramidal masses between them. Such cols, as far as I know, are of limited occurrence in the Cascades, but the older peaks in most cases are pyramids rather than cones. Mt. Jefferson, which has been called the "Matterhorn of America" is a good example.

While we are on this subject I wish to called attention to the very fine example of a particular feature of glaciated country shown on the north side of the South

Sister and known as the *bergschrund* (literally mountain rift). It is the boundary crevasse between the neve and the glacier. Mr. Williams* calls attention to this feature in his bulletin but does not use this term. This is such a marked feature of glaciated countries that it should be perfectly familiar to all Mazamas.

So much for the superstructure—what about the foundation and lower floors of this great geological edifice? The foundation of the Cascades few persons have seen. It is visible at only a few points where it outcrops deep down in the lowest-cut canyons. It is represented by several outcrops of granite or *granodiorite* which are offshoots, in the writer's opinion, of the great Sierra granite *batholith* of California.

Above these come piles of sediments, sandstones, shales and more conglomerates, and all these make up the first story of the structure. On top of these and in such great heavy masses as to cause the whole substructure of sediments to sag visibly under the enormous load, which has never been calculated but which certainly amounts to billions of tons, lie sheet upon sheet of basic lavas, *andesite* and *basalt*. Interbedded with these are some hundreds of feet of volcanic ash or tuff and even coarser ejecta called agglomerate. This pile is like unto a great layer cake. Into this series of layers, numbering more than a score in places, streams large and small have made great gashes and these gashes have subsequently carried tongues of living ice which softened and rounded their contours and now we see them as beautiful valleys. We have then, as has been pointed out by many others, a dissected plateau rather than a series of ranges.

And last and uppermost we have the rock pyramids and

**Mazama, Vol. 5, No. 1.*

cones of the Sisters, Jefferson, Hood and others rising above the noble forests like the towers and minarets above a Moslem city. Did you not feel as the departing sun lit up those great rock piles with the matchless alpine glow, that indeed it was the hour for prayer and meditation!

We must take a little excursion at this point to the summit of the McKenzie highway to have a look at the Lava beds in order that we may see the latest volcanic activity in this region. Here from the vantage point of the newly constructed observation tower built by the Forest Service, we can look over a vast field of very recent lava flows which came from the throat of old Belknap crater to the north. We are reminded of the waste land of some of the country on the slopes of Vesuvius or of the Hawaiian Islands.

Great piles of rough "*a-a*" lava lie in disordered heaps as if some giant "bulldozer" had shoved them up here. One can still visualize them as still smoking and glowing as they poured down the slopes in remorseless overwhelming streams. It is probable that this eruption occurred not more than a few hundred years ago, as there is relatively little weathering and scarcely any vegetation on these latest flows.

I have said little so far about the interesting phases of the past and present glaciation in this beautiful region and I do not purpose to do so. Personally I do not care for glaciers; they are cold, forbidding things, and their work is usually destructive, unrelenting, and remorseless.

I have thought how fortunate we are to have this wonderful geological laboratory right at the door of our educational institutions. Never have I seen in so small a compass and so accessible such an array of things of major interest to the geologist. Were I a botanist I would doubtless be equally satisfied. Those upland

meadows and pastures make it unnecessary for us to go to Europe for the Alps—they themselves are true Alps—high mountain pastures. It has also occurred to me that the Three Sisters region might very appropriately be set aside as a State Park. I am glad there are some things in life upon which a cash value has never been placed, which cannot be bought, sold, given away or stolen. I have a little tinge of pity for those lowland peoples who have never stood on the pinnacles of the world and looked away beyond the dwellings of men—who have never grappled with Nature in her wildest moods. There are times when it is good for the soul of man, and his body too, to have to wrestle with something and to conquer it, if for nothing else than just to down it. You who have stood amidst the crackle of electricity on the lonely mountain top, you who have looked into the bowels of the ice-stream, you who have gazed into the yawning hissing throat of a volcano, you who have listened to the silence of the night in the fir forest or far above the snowline, you have indeed a "sense of deeper things."

"And I have felt a presence that disturbs me with joy
Of elevated thoughts: a sense sublime of something far more deeply interfused,
Whose dwelling is the light of setting suns
And the round ocean and the living air
A motion and a spirit that impels all thinking things,
All objects of all thoughts,
And rolls through all things."

And so we go on in life from gaping craters of sorrow, through dim and misty jungles of misunderstanding and doubt, out over sunlit stretches surrounded by friends, and up, ever up, to the Sinai of some great inspiration.

"My eyes dim for the skyline
Where the purple peaks aspire,
And the forges of the sunset
Flare up like golden fire.

"There crests look down unheeding
And see the great winds blow
Tossing the huddled tree-tops
In gorges far below;

"Where cloud-mists from the warm earth
Roll about their knees
And hang their filmy tatters
Like prayers upon the trees.

"I cry for night-blue shadows
On plain and hill and dome,—
The spell of old enchantments,
The sorcery of home."

—BLISS CARMAN.

ORCHARD SCENE IN WILLAMETTE VALLEY

State Hgw. Dept.

FOREST SCENE — DEER IN VELVET

Photo Courtesy U.S. Forest Serv.

CROOKED RIVER BRIDGE

State Hgw. Dept.

Chapter V.

THE GHOST FOREST IN CLEAR LAKE

HIGH up in the Cascades, in the midst of a virgin forest of firs and cedars is one of Oregon's most interesting new recreation areas, recently opened up by a new forest road. This is Clear Lake, and when we say Clear Lake, we mean just that.

This lake is famous for having a unique exhibit in connection with its other attractions. It has a submerged forest beneath those clear waters and one can ride over the tops of immense trees of two to three feet diameter and look down and see the base, or nearly the base, far below.

It seems that about one thousand years ago, as nearly as we can estimate the time, a lava flow streamed down from Belknap Crater to the westward and flowed into the old valley of the upper McKenzie and dammed it, producing this beautiful lake of quiet, clear waters. There were forest trees growing on the sides of the old McKenzie canyon and consequently when the dam was made by the great lava streams, the trees were "drowned standing up."

There is a fine new forest camp directly at the lakeside with open air fireplaces, and boats for rent close by.

On the way in from Belknap Springs Junction on the McKenzie Highway after one has gone about fifteen miles he comes to the lower falls, a beautiful cascade of some fifty feet drop over a basalt ledge. Proceeding further one pauses at Prospect Point only a few feet off the trail and looks down into the Upper McKenzie canyon. This is not

a great canyon as canyons go, but it is a beautiful view, chiefly because of the great expanse of practically virgin fir forest.

Climbing a little higher one comes to two more falls, Upper Falls and a little baby falls.

Clear Lake lies at an elevation of 3030 feet and covers about two square miles. It is 190 feet deep in the deepest part and is fed by large springs of seep water from the porous lavas. The largest of these springs is Giant Spring near the north end of the lake on the east side. The summer temperature of this water is about 41°. The submerged trees can be seen best at the north end of the lake. These trees, some of which are nearly 3 feet in diameter are perfectly preserved in the cold lake water and are the same kind as those now growing on the neighboring hillsides. None of them stands out of the water, most of them having lost their tops by decay in the air, while a few have been cut off so as not to impede the boatmen on the lake.

As one looks down at the bottom of the lake in the shallower portions, he will see a creamy-white deposit there. This is diatomaceous ooze and examined under the microscope reveals myriads of tiny, crescent-shaped lenticular bodies which are the tests, or outer casings of the primitive single-celled plant known as a diatom. These lowly organisms are living and floating in many of the lake waters of Oregon today. When the plant dies its "shell" sinks to the bottom. In several localities in Oregon, there are extensive thick deposits of these representing the accumulations in prehistoric lakes from which the water has entirely disappeared. This diatomaceous earth, or diatomite, as it is called, has considerable economic value as it is used in something like a hundred different industrial uses, as filter material, paper filler, insulating material, and cosmetics, etc.

These lava flows at Clear Lake are of the type called in Hawaii "A-a" lava. They are exceedingly rough and jumbled up and one finds it very laborious to travel across much of their surface.

How long ago did this damming of the old river valley take place? At present, no one can say definitely, but we can make a very good guess that, I believe, is not more than a few hundred years out of the way.

"Not more than a few hundred years?" I hear you ejaculate with just a bit of sarcasm in your tone of voice.

"Why can't you be more exact?" you say. Well, I'll tell you why. First of all it happened long before white men came to America and if there were any Indians around at the time they were too frightened to make any record of such an occurrence, and, besides, the Red Men have never been strong for recording accurately such events. I never even heard of any Indian legends about this lake so I feel sure that no Indians were anywhere in this "neck-of-the-woods" at the time. Well, then, let's see if there is any other clue to the mystery. Suppose we pulled out one of the buried trees and counted the rings, would that tell us anything? Yes, it would tell us how old that particular tree was when it stopped growing. We did that with one—it had 125 rings. However interesting that fact is it tells us nothing about what happened after this tree stopped growing which might have been one hundred or one thousand years ago or even more. Of course if we could make a graph or curve of this tree-ring record showing the cyclic contractions and expansions in the tree's growth and found a living tree in this same region whose tree-ring record showed at certain points, peculiarities which could be matched in the record of the dead tree we might be able to date the catastrophe which overtook it. However, such correlations are fraught with considerable

difficulties and they are quite unreliable unless we know a great many things. A more reliable way, but still inexact method, is to fell the largest tree now growing on the surface of the lava which caused the formation of the lake and count its rings. Suppose such a tree had rings indicating its age to be 600 years, we could say that this event we are trying to date occurred at least 600 years ago. But, and this is the difficult point, how long was it after the eruption of the lava before the tree got rooted in this lava? That point we do not know and we can only guess at it.

In the East Indies, after the eruptions of Krakatau it was only about five months before vegetation was well started on the slopes of the wrecked volcano. This, however, is in the very humid equatorial region and quite different from the region we are dealing with in the McKenzie. I think we should allow anywhere from 100 to 200 years for a tree to get a start on this lava surface. All I can say at the present writing is that this lava is unquestionably older than that at the summit of the Cascades, and judging from the size and amount of the vegetation now growing on its surface, its degree of weathering, or disintegration, that the eruption occurred from 800 to 1000 years ago.

When you have thought about this problem till you are tired, and caught all the fish you can eat, then you should continue on to Fish Lake, which in summer is not much of a lake, and then eastward by way of the new Santiam Highway. This will take you within a stone's throw of Blue Lake, a small lake occupying a deep irregular depression in the lava surface whose waters are just as blue as those of Crater Lake, and finally to Suttle Lake, an excellent summer resort. From Suttle Lake it is almost a straight run over a beautiful oiled road out to the Sisters.

For scenic, geological and botanical interest this trip is one of the finest in all the Cascade region.

Chapter VI.

THE STORY OF MT. MAZAMA

IN THE southern Cascades of Oregon, at an elevation of 6177 feet, is one of the world's outstanding scenic and geologic wonders. People from all over the earth have come to marvel at its beauty and puzzle over the mystery of its origin. During the past year, over 118,000 persons visited Crater Lake in Crater Lake National Park. The writer, as a Ranger Naturalist, helped explain this remarkable physical phenomenon to many of this number, and the following story is told as if we were standing together on the rim of the great crater.

By way of reminder, let me say that this lake is situated in the throat of an old volcano produced by the disruption of a prehistoric mountain later named Mt. Mazama. The lake is 21 miles in circumference, 6 miles in diameter, is 1996 feet deep at the deepest point yet sounded and the crater walls rise above the lake from 1000 to 2000 feet. By careful computation it is estimated that some 17 cubic miles of material have been removed from this mountain.

Some people come to view this spectacle for the sheer beauty of the scene, the indescribable blue of the lake, the marvellous reflections of the crater walls in the still water, some to study an old dissected volcano, while others are intrigued by all the various aspects, but chiefly by the mystery of it all. Whether you look upon this scene as a geologist or as an artist or merely as a wondering tourist, you are profoundly affected by it and you will carry away

an impression never to be erased from your memory.

John Wesley Hillman discovered Crater Lake in 1853, but it remained for the late Dr. J. S. Diller and Major C. E. Dutton of the United States Geological Survey to discover Mt. Mazama. These two men by their laborious and careful work toward the latter part of the past century reconstructed this prehistoric mountain so faithfully that with only minor additional observations, we are able to place before even the most casual tourist a most real picture of this old monarch of the Cascades.

Looking to the north and south from our vantage points on the rim, we see the broad lava platform of the Cascades on which Mt. Mazama, Shasta, Three Sisters, Jefferson, and Hood rise as superstructures. All of these mountains with the exception of one are relatively intact and except for some ice, water and wind erosion effects, they maintain some semblance of their former outlines. Not so Mazama: its whole upper portion is missing. To reconstruct its former condition we must note first of all that its history of building was one dominantly of explosive activity which would of necessity produce a conical shaped mountain and not a low lava dome. Second, its back slopes which one can see at many points on the Rim Drive indicate how the curve of those slopes would extend if projected upward, and last, the size of its base which can be measured, will give one a clue as to its magnitude in comparison with other Cascade Mountains. By putting together all the observations of the inner and outer parts of the present crater, one can bring out the main steps in the history of this old mountain. In doing so, we should call attention to the 1. Materials—their composition, distribution and texture. 2. Profiles—that is, the importance of geological line or pattern which may have entirely different meanings from those the artist sees. 3. The factor

of time, not actual, but relative ages of the materials and happenings.

It is very likely that Mt. Mazama started out on the Cascade Plateau, very much as Wizard Island volcano did and as most volcanoes do, i.e., as a small cone. It grew larger and larger, but intermittently, literally by "fits and starts." There would be times of quiet-up-welling and outpouring of lava to be followed by great paroxysms of violent explosions. This is not a matter of conjecture, for the crater walls carry the inescapable record. There were periods, too, of quiescence when the slopes of the mountain at different stages were forest-covered and long erosion intervals occurred.

Geologists and others, who came long after Diller and Dutton, have dug into the crater walls and found beneath sixty feet of debris, portions of old charred stumps and logs. The long erosion intervals, when valleys were cut in the old lava slopes, are proved in many places by the unconformities where valley profiles cut across lava flows and beds of fragmental materials. One such unconformity is remarkably well exhibited in Red Cloud Cliffs where a v-shaped valley was cut; i.e., by stream action and not ice in the early horizontal (in cross-section) lava flows and later filled by a solid flow of lava.

There were also other events of importance in the life history of the old volcano quite different from its episodes of igneous (fire-born) action, such as the accumulation of great snow fields on the highest slopes and streams of ice fed by these fields of neve, coursing far down the lower slopes. The records of these are found on all sides of the present crater, both inside and outside of the present rim. These records are of three kinds, U-shaped valleys, like Kerr and Sun Notches; glacial scratches like those of Discovery Point on the north rim between Watchman and

Llao rock and on the Watchman itself; and moraines, at many points on the rim, especially at the heads of Munson and Castle Creeks. Records of at least two and perhaps three separate periods of glaciation may be noted in one's study of the crater and its back slopes. In this connection it may be pointed out that it is not at all improbable that some glaciation occurred after the destruction of the main mountain and that this catastrophe took place in the last inter-glacial epoch which, if true, would enable us to date this cataclysmic event at about 20,000 years ago.*

In trying to get some conception of the height and shape of old Mt. Mazama, we are aided by the knowledge that mountains of the explosive type, (which are the rule on the Pacific rim) the slopes follow approximately the sine curve. Bearing all these facts in mind, Diller restored old Mazama to a height of approximately 15,000 feet in elevation. With this height and circumference at 7,000 feet (the general rim elevation) we would have a volcano here in the former times comparable to Mt. Shasta today.

Having built our old Mountain up to its full height, we are now ready to decipher the next chapter in its history, which was one of destruction, rather than that of construction. That something of tremendous consequence and involving forces of unbelievable magnitude were at work here is evident even to those least versed in geological lore. But just exactly what, and how it happened, is not so easy to decide. We know that a mountain mass of approximately 7 or 8 cubic miles above the present rim towered up into the blue, also that the present crater contained another mass of material, the whole totalling some 17 cubic miles of rock, and that now all this is gone. Here comes the rub—for competent geologists do not agree as to

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*Recent geological studies seem to point to a more recent date.

just what did transpire, like doctors who often disagree in the diagnosis of what ails a patient. If doctors disagree in a diagnosis it may be "just too bad" for the sick one, but in this case, the patient was old Mazama, and apparently the old fellow is quite dead, and therefore it hardly seems a vital matter to decide what did happen. There it is: we are faced with a fact of tremendous import, and not a theory—why worry our heads about theories, why destroy the mystery? Let old Mazama rest in peace and its present beauty, and let us be content to enjoy the great spectacle.

This would be sufficient for most people, but geologists are curious, perhaps overly curious people who are not satisfied with sheer beauty—they want to know, and some day they will solve the mystery of the "Old Man of the Mountain."

Now among several possible theories we have two outstanding: one, the theory of collapse and engulfment, the other that of explosion. Space does not permit us now to discuss fully these quite antagonistic points of view, and, furthermore, the discussion would involve so much that is technical that my readers would perhaps become weary. Suffice it to say that the trend of opinion among many geologists, among them several foreigners of note, appears to be in the direction of a modification of the older notions, that is to say, toward the theory of explosion. Several knotty points will have to be cleared up, however, before some students of the subject will be satisfied.

With due regard for the fine work in the early days by Diller and Dutton, the present writer feels bound to disagree with their final interpretations of this important chapter of the geological story. On several grounds is he led to the conclusion that explosion was the dominant factor in the wrecking of the old mountain. In the first

place, explosion and not collapse is the rule in the destruction of volcanoes of this type, especially is this true on the Pacific rim. Second, the amount of fragmental material, chiefly pumice, scattered far and wide, literally over hundreds of square miles and hundreds of feet deep, with Crater Lake as a center seems to point clearly toward explosion as the final catastrophic phase in this tragedy of the Cascades. Third, the crater itself is an explosion crater and has very little resemblance to the *caldera* of Kilauea in Hawaii, with which it is most frequently compared. And, finally, since the dominant forces in the earth are working outward, at least in connection with vulcanism, on purely mechanical grounds, collapse of a great mass, where before so much material had been extruded, does not seem to be reasonable. Howel Williams of the University of California, a vulcanologist of note is inclined to the explanation involving both explosion and collapse.

After the formation of the crater by whatever process, the volcanic energy was not altogether spent, since three new baby cones were built up within the wreck of the old one. Two of these have been submerged by the waters of Crater Lake. The other, Wizard Island, the head of the mythical Indian god, Llao, remains holding itself proudly above the blue waters, defiant even in death—its fires burnt out (or are they only slumbering?). And so closes the geologic epic of the building, destruction, attempt at rejuvenation, and final extinction (perhaps) of a proud monarch of the Cascades. Peace be with you, old Mazama!

You have read a partial account of what one geologist thinks about this mysterious place. How did the early Indian interpret it? Here, very briefly, is one part of the Indian legend as arranged by W. Craig Thomas, former ranger naturalist at Crater Lake. This episode deals with the great eruption which followed upon the refusal by the

Indian princess of the hand of Llao, the god of the lower regions whose throne is Llao Rock on the northern rim of the Crater.

The Eruption.

"Thus came discord upon the world and the first cleavage between gods and men. And it distressed Lla-O when he saw what he had done, but none can consort with evil powers and avoid their poisons. Demons were his cohort, nor could he endure the doubt within him that if mortals and their kind might refuse his commandments, was he longer a god. Even his own people shrank from his presence and marked how he sat, day after day, gnawing his knuckles as an old dog a bone, and flashing the lightnings from his eyes over the skies of the Klamaths.

So after a time, he dispatched a new messenger to the people of the valleys and the chieftain of those peoples stating that if, before the end of the third day, the maiden were delivered to him, the Klamath nation should become invulnerable and none would dare oppose them. But if his demand be again refused, he would bring against them all the agencies of his lower world; that the earth would open and swallow up their homes and the homes of their fellows; and that the heavens should rain stones and fire; and the yellow water-smoke should come down into the valleys and the funeral dirge be ended, only when there lived no more to chant.

Thus Lla-O sent three days of terror and despair upon the Klamaths, for the maiden was the heart of every man and each would have died to save her from Lla-O if such saving could have been done. And the maiden herself had called them together, for they were her brothers, and she told them that she should be cast into the trap of Lla-O for the salvation of her people. But they restrained her

with thongs about her wrists and about her feet, within her father's house.

So descended the sun upon the third day, nor did it vanish as before, but withdrew itself at the horizon with an amazing cloud of light. Then the people of the valleys who knew that infernal things were about to appear, cast themselves to the ground, and each covered his face that he might not witness the approaching spectre of death.

Thrice the ground beneath their bodies bellied and sank again, until the trees broke their branches against another and great rocks bounded down the mountainsides, driven from their places by what occurred. Then while the whole world seemed to groan aloud with intolerable rupture, and with such a sound as had never before been heard, the throne rock of Lla-O burst upward and outward, and great objects and smaller fell through the air, bearing with them the very stars of the heavens.

Full seven days no sun was seen and there was no way to tell this day from another, and there was no light save the glare of the flaming mountains, and every day of those seven days the yellow water-smoke took toll in agony from those that could not live. And this was the time for fire and torture, and rapine in the land, until Tlama, greatest of all the gods, arose in anger and demanded of Lla-O that these things must cease.

But Lla-O had gone mad with the bloodshed and the tumult and he asked of Tlama whether these men had not affronted him, and refused his commandments, and was it untrue that the subjects of Skell had tricked him out of his vengeance beneath his very hand. And Tlama knew that Lla-O spoke the truth, and he also knew that the fault was with Lla-O, for he had fallen enamored of a mortal woman against the wills of the gods and had continued his quest of her in defiance of them."

And now just before we close this chapter, let us in fancy at least, sit down on the crater rim of Wizard Island within this lake of beauty and death, and hearken to the sounds that come from the "further side of silence," or better yet, set sail upon the Phantom Ship, sail outward to the sunset into the land of our dreams.

Recently several discoveries of human artifacts have been found beneath pumice from the explosion of Mt. Mazama which lead the students of this subject strongly to believe that man witnessed the destruction of this mountain. Dr. L. S. Cressman, head of the department of Anthropology, University of Oregon, has just announced the results of his far-reaching researches in this field before the section of Anthropology of the Sixth Pacific Science Congress at Stanford University (Aug. 1939).

Can you not picture the utter consternation and ensuing panic among those primitive dwellers of early Oregon as they faced the awful spectacle of exploding Mazama and how they must have called upon Llao to moderate his wrath!

Crater Lake

(From the Rim)

Time shuts the old earth giants all away
In cool far dungeons where his years lie deep.
But rarely does he grant, as here, to play
Smiles that light with loveliness their sleep.

MOLL in *Blue Interval.*

Chapter VII.

"WHERE ROLLS THE OREGON"

MANY have been the attempts to describe the mighty river, now called the Columbia, and its wonderful gorge where it has cut its way through a great mountain range on its way to the sea. We do not pretend in this chapter to do this full justice,—to succeed where others more gifted have failed. It simply is not within man's feeble power adequately to portray this, the mightiest river of the West. It is too colossal an undertaking.

The Columbia and its gorge are important in at least four ways. First, as a natural defile through a mountain barrier, it has provided a thoroughfare either by air, water, or land.

Second, it is the most important fishway in Western America, the salmon catch amounting to millions of dollars annually.

Third, it is a source of power, only recently realized through the Bonneville Dam.

And the river is perhaps far more important as a thing of superb beauty—a delight for the soul of man emerging tired and distraught from his hectic milling around in cities.

Let's put ourselves in the place of those earliest Indians who had trailed slowly down the coast from Alaska. Imagine their amazement as they caught their first glimpse of the great stream and followed it slowly, for years, perhaps, to its headwaters; or of the navigators coming by

way of the Horn, who first saw a broad opening in the rock-bound coast, indistinct in the fog. Perhaps this was the entrance to the Northwest Passage! What a thrill to stand on the bridge of the good ship Columbia when on May 11, 1792, Captain Gray steered her across the bar and entered the stream that Heceta had so narrowly missed!

Or, stand beside those intrepid explorers Lewis and Clark when, over a century ago, they crossed the divide and placed their canoes on the waters of the Clearwater, the Snake, and finally the Columbia. Again we might leap ahead through the years and imagine ourselves at the little trading post of the Dalles with the emigrants of 1843 venturing for the first time on its turbulent waters rushing toward the falls at Celilo. A portage, and again we are on the bosom of the mighty river making its broad sweeping curves toward the mouth of the Willamette.

And now the modern tourist comes zooming through the Umatilla wheat-lands in his high powered car covering in one hour more miles than the early ox-teams could do in several days. What a sight unfolds before him as he drops down to the river's margin and begins to wind about the local headlands and ravines as he whirs through the gorge. Or, perhaps, as he comes roaring down in the night in a stream-lined train from the summit of the Blue Mountains, how cool and inviting the river with its willow-lined banks looks after the long hot trip across the semi-arid plains to the eastward.

What did the Indians think about our great river? Most of the legends available to us seem to center around the well-worn theme of the "Bridge of the Gods." For one interesting variant of this story we are indebted to the late Judge M. C. George, of Portland and The Dalles. It runs something like this:

"A more fanciful legend, was that the Great Spirit raised the Cascades to separate Indian tribes, but created a great Tomanowas Bridge. On it he stationed Loowit, a beautiful maiden, because of her faithfulness, whose duty it was to keep a fire burning. All Indian Chiefs fell deeply in love with her, and as a result Klickitat from the North, and Weyest from the South, made desperate war, ravaged the land and brought on misery and wretchedness. This provoked the Great Spirit, who in wrath broke down the bridge and put to death Loowit and the rival chiefs. But in commemoration of their former noble lives he reared snow-capped monuments —for the maiden, beautiful St. Helens; for Klickitat, the dome of Adams, and for Weyest, the spire of Hood. Thus the Bridge of the Gods was created, then destroyed, and Hood, Adams, and St. Helens, as silent guardians of the Columbia, established."

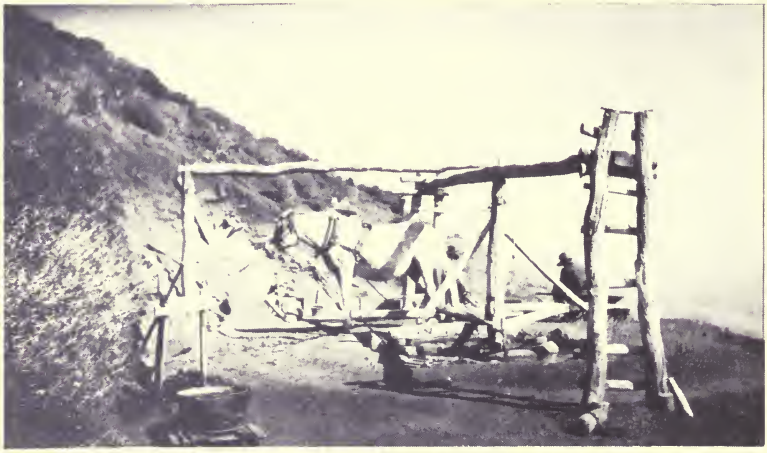
The real facts about this mythical bridge as learned through a geological examination of the terrain indicate that there was a great landslide or succession of slides on the Washington side of the river when millions of tons of rock broke away from Mt. Hamilton and Table Mountain. As a result of this tremendous slide the Columbia was forced out of its old channel and now follows a new course south of the old one.

To sketch the geology of this river in a few paragraphs and in popular language is not easy. The first approach to this was made many years ago by the late Israel C. Russell of Michigan; this is found in his book on the "Rivers of North America."

Since his time much work has been done by two other men especially, the late Ira Williams of Portland, and Professor E. T. Hodge, formerly of the University of Oregon and latterly connected with the department of geology at Oregon State College. Williams gives a detailed description of the entire gorge with copious illustrations and a strip geological map. Hodge, who differs quite radically in the interpretation of the history of the river, has written a challenging discussion of a part at least of the river's history under the title, "Columbia River Fault."

MILLER'S CHAPEL — OREGON CAVES

BASCO HOUSE, CATLOW VALLEY



MEXICAN ARRASTRE, PUEBLO MT., S.E. OREGON

Without going into any of the evidence for some of these statements we may very briefly summarize the general geological set-up as revealed by a close traverse of the stream. Such a general perspective shows a great trench made principally through erosion, but in all likelihood predetermined by one or more great fractures or faults, in a tremendous pile of volcanic flows and interbedded accumulations of ash and coarser fragmental material. The greatest thickness of this series of formations has been measured as 4,960 feet near Mt. Defiance. The lowest member of this group of formations is a consolidated mixture of mud flow and volcanic "conglomerate" known as the Eagle Creek formation. Above this comes the Columbia River Basalt of 1500-2000 feet average thickness. Next above a gravel formation called by Bretz, the geologist who studied and named it, the Satsop formation. Above this is a great accumulation of varying thickness of andesite, a lighter colored lava which gets its name from a similar rock in the Andes Mountains of South America. At the top of the heap there are the comparatively recent volcanic eruptions represented by nearby Mt. Hood and Mt. Adams.

As one drives through the gorge he will note that these great volcanic accumulations have suffered certain deformations since they were first laid down—they have been folded into a series of at least two gentle arches known (from west to east) as the Binger anticline and the Ortley anticline. These arches do not appear in the upper part of the section and hence occurred before the andesitic eruptions.

The older interpretation of the history of the river is to the effect that the river was flowing westward on an older and more gentle surface before the Cascades were uplifted and that the river simply sawed its way across the rising

folds of rock. Later interpretation by Hodge favors a different history and stipulates that the river is what is called a *superimposed* stream which broke across the Cascade barrier subsequent to its elevation resulting in the draining of an immense lake impounded behind the giant rocky wall.

Whichever version we may choose, we have here a most interesting geologic story. Because of the deep section cut by the river one can almost read the story as he runs (or rolls) along. However, if we run too fast we lose many interesting and important details.

One of the relatively recent episodes in the life of the Columbia has only lately been deciphered by another geologist, by the name of Allison, who pictures a gigantic ice-jam in the lower Columbia below the present site of Portland which backed up the water in a great lake as far as Eugene with the lower or northern part several hundred feet deep. In these waters floated great icebergs or ice rafts which bore many boulders of foreign rock brought down from the melting glaciers in the Washington Country. This is a variant of the old Willamette Sound theme of Condon who early noted these same erratic boulders of granite and quartzite here and there in the Willamette Valley. He thought of this body of water as like Puget Sound today, but the evidence favors Allison's theory. This damming of the mighty river occurred in the Pleistocene, anywhere from ten to fifteen thousand years ago.

As we whisk rapidly, all too rapidly, through the gorge we shall have time merely to point out a very few outstanding scenic and geological features which you cannot afford to miss in your journey through this part of Oregon.

Go first to Crown Point, since from this vantage point

one gets the best panorama of the river, both to the east and the west.

Multnomah Falls, while not the highest nor the largest falls in the world, is one of the most beautiful to be found on any of five continents and it can be depended on to keep flowing the year round, something that some falls, more widely publicized, do not do. Though not the highest, yet a sheet of water dropping 620 feet, it makes a spectacle of great beauty. Furthermore, it is the lovely silvan setting against the background of basalt cliffs and riotous greenery that gives Multnomah her great beauty. Yet, this is only one of a score or more of lovely cascades which line the sides of the gorge, prominent among them being Bridal Veil, Latourell, Shepards Dell, Coopery, Elowah, and Horsetail.

One of the most striking scenic features in this galaxy of natural wonders is Oneonta Gorge, an amazing rift in the canyon walls, so narrow that one can almost span the cleft with his out-stretched arms. It has been formed by a tributary stream working back along a fracture in the canyon wall.

At Mitchell Point there is a remarkable tunnel of basalt which has windows cut through the solid rock permitting the traveller to get a superb, fleeting view of the river. This tunnel was patterned after one on the Axenstrasse in the Alps.

We have not described, and in fact can only barely mention other interesting features like St. Peter's Dome, Cascade Rapids, Cape Horn, Rooster Rock, etc., but all of these you will see if you do not go too fast. Remember, Mr. Traveller, you are not going through this canyon "just to arrive at the other end." Don't be in too great a hurry, or you will miss something. For instance, there are the fossil leaves in the Eagle Creek formation at Eagle

Creek. Many of the trees represented by these leaves are now extinct. One of these trees formerly very important in Oregon is the Ginkgo, still found however in Japan and lately reintroduced to America. Specimens of the leaves may be found in the fine-grained dark ash of portions of the Eagle Creek formation below the highway level (See Highway marker).

However, there are other aspects of the river which will interest some people much more than does natural beauty. For years men have looked at the tremendous power going to waste in this stream and have yearned to harness the million wild horses and put them to work; and now, today, it is done. At Bonneville you will see this dream come true. On a "sill-dike" of hard igneous rock firmer than the surrounding formations the Army engineers have built a great dam using Bradford Island as a sort of pier. This dam and power plant will generate, when complete, over 200,000 kilowatts of electricity. Locks have been constructed which will enable large barges to go up to The Dalles and other interior points for shipments of grain and other produce. There is one serious "fly in the ointment" in this project—and that is the problem of the fish getting by the dam in order to go up stream to spawn. If the fish can get by the great obstruction all well and good—if not, then it becomes a serious matter—power and transportation versus fish—which is the more important?

And so this brings us to consider the river in relation to modern commerce. First, the river was a boatway, for small boats and canoes, navigated only by the most daring and skilled among the fur traders. Later came the railroads which used the natural defile provided by the gorge. Then followed by the highway carrying along a constantly increasing stream of tourists. It was only natural that the

intrepid airmen should next use this route to and from the interior. Finally with the building of the locks will come the era of the ship and the river will reach, perhaps, its full-tide of usefulness as a servant of man. With this will come a great era of industrial development—and yet—there will be those who will regret the passing of the old-time river. Already the red man looking across at Memaloose Island, the graveyard of his ancestors, and knowing it will soon be under water, predicts dire consequences as a result of the White Man tampering with his stream. But it is the old, old story. If man had listened to all the dire predictions and warnings of the conservative ones of this earth where would he be today?

And now by way of closing let us for a moment forget progress and turbines and consider briefly the significance of the river. I have always regarded a river as more or less symbolical of the life of man. That part of the river far up in the mountain cradles corresponds to the life of the infant and of the child. A little further down toward the plains, where it has grown stronger, it is rushing along with the exuberance of youth madly leaping and turbulent at times with occasional pools of quiet water which might be likened to those short pensive dreamy spells of the young man or woman on the threshold of early maturity. Still farther down the slope the river becomes deep and wide and full with a strong steady current with only rare breaks of more rapid or slower passage. This is the full maturity of the stream which corresponds to the years between thirty and sixty in human life. After that the stream and the man both slip into old age—the stream sluggishly meanders in its wide flood plain of great vistas and man begins to totter and has to support himself with his cane. Uncertain though his steps and somewhat dim his vision compared with views from the mountain slopes, his mental vision as

a result of experience is greater, his life full of experience and memories. And out beyond the mouth of the river is the vast deep into which it drops quietly and merges with the waters from whence it came. So the human life goes into the long sleep and the human spirit rejoins the Cosmic Spirit from which it sprang.

Chapter VIII.

"WY-EAST—THE MOUNTAIN"

"ONE AND one-half hours from roses to snow." This is the experience of one who drives the sixty-three miles via the famous Mount Hood highway from the metropolis of Portland to Timberline Lodge, Oregon's spectacular alpine rendezvous anchored half way up the southwestern slope of Mount Hood— "a million-dollar resort in a million-acre playground." Thousands of people ski here from November until July on the gentle, timber-free slopes for beginners; or steep, twisting trails for experts; or on the class A, B, and C jumps for competitors. Fresh "powder" snow falls on the well packed base every few days from November until April, after which spring and summer skiing continues on "corn" snow until July. Some ski on glaciers through August, September and October. The world's longest chair-type ski lift which cost approximately $80,000 starts near the Lodge and lifts its passengers a mile higher on the mountain. This is supplemented by several nearby tows.

The lodge itself, a massive four-story stone and wood structure pronounced by critics as a remarkable piece of craftsmanship, introduces to the world a new type of architecture known as Cascadian. It is located a short distance from the old Barlow Pass, where Oregon's pioneers "looked over the rim of the long, long trail into their promised land." Its hand-crafted furnishings and noted murals have caught and held for posterity something of the spirit of those early men and women.

Although skiing apparently holds the spotlight among sports in this area, visitors to the twelve-month playground may ride sure-footed western ponies along trails winding through virgin forests; fish in the numerous lakes and streams; climb this most-climbed of American glacial peaks; or participate in much less strenuous sports such as golf, archery, badminton and table tennis.

There is fun for everyone—summer and winter—in Oregon's mile high playground, but what of the dormant volcanic peak, reaching an elevation of 11,253 feet to take its place among the great peaks of the Cascades reaching from northern California to Alaska? The mountain is a composite volcanic cone made up largely of andesitic and basaltic lavas with a partially destroyed crater on the top. There is still some deep seated volcanic activity here as evidenced by the fumaroles in the crater and lower down on the south side at Crater Rock. Deep scars on the slopes testify to extensive glaciation in the past, and remnants of some eight or nine glaciers still remain. It is on these that ski enthusiasts find sport in August, September and October after snow on other parts of the mountain has given ground to the sun and warm winds.

The geology of the mountain has been studied by two men particularly. The late Ira Williams of Portland wrote an account of its geology some years ago in a small booklet published by the Mazama Mountain Climbing organization. Later, Dr. E. T. Hodge of Oregon State College made a more complete study of it, publishing many articles on the subject.

Almost as interesting as the mountain itself are some of the men who have lived on it and near it. One of these is the veteran lookout and guide, Elijah Coleman, who has climbed it so many times that doubtless even he lost count. A man of prodigious stamina and iron nerve, he devoted

his life to heroic service on the mountain. The other person was "Dad" Aschoff, a man of Austrian birth who lived on the lower slopes of the mountain and who made the first nearly complete topographic map of the area. "Dad" was a Mazama and was greatly loved and respected by all who knew him.

In fine weather the old mountain turns a kindly face upon its visitors, but during stormy periods it has claimed the lives of scores of the unwary who either did not understand or failed to heed the vagaries of the big mountain in an angry mood.

It has been reported recently that the area is being discussed as the next national forest to be set aside as a national park.

We should not close this all too brief chapter about Mount Hood without recalling at least one Indian legend built around it. Let me relate here briefly one which the reader will find in more complete form in Fred McNeil's book "Wy-East, the Mountain". This is the Klickitat fire legend.

Yi-east (Mt. Hood) and Klickitat (Mt. Adams) dwelt on the western shore of the sea. Into a little valley between them moved Beautiful Squaw Mountain. The two brothers fell in love with her but she grew to like Yi-east and because of this the two brothers quarreled and were soon fighting. They growled and rumbled and stamped their feet until the earth shook. Then they spat ashes and fire, belching forth great clouds of smoke. They paid no heed to the pleading of Koyola, the demi-god, but discarded their white robes, painted themselves with streams of liquid fire and hurled white-hot rocks at each other. When they finally tired of the battle, the forests were burned away, the game killed and the people who survived lived in caves. A great hole had been torn in the range between

them and the waters raced through it, wearing away more and more soil and rock until there was a tunnel through which a river flowed under a natural bridge (the Bridge of the Gods).

Beautiful Squaw Mountain had fled in terror to a cave where neither rival could find her. Each brother blamed the other and the fight was about to resume when the Great Spirit came to earth and stopped the quarrel. He decreed that Beautiful Squaw Mountain should remain hidden forever and that the natural bridge should stand as a covenant of peace between the two brothers. Loo-wit, an ugly old woman, was placed to guard it and to remind the two mountains that woman's beauty is not everlasting.

But after many years Beautiful Squaw Mountain grew tired of her hiding place. She arranged to slip out at night and meet Yi-east. But they became indiscreet and Yi-east was caught one morning trying to get back across the bridge. The Great Spirit was angry but he realized how lonely Beautiful Squaw Mountain was and allowed her to remain out, but he would not consent to her marriage with Yi-east for fear of angering Klickitat again. However, Klickitat did become angry and resumed his quarrel with Yi-east. Again the people fled and the game perished. The brothers threw so many stones that they broke down the bridge. But the battle raged until Klickitat won. Yi-east renounced all claim to Beautiful Squaw Mountain. She went to Klickitat, heart-broken, and sank at his feet in a deep slumber. She is known today as Sleeping Beauty. Klickitat had truly loved her and was so grieved at her fate that he bowed his head and has never raised it since.

Loo-wit, the old woman guardian of the bridge, was changed into a young and beautiful mountain by the Great Spirit. Today she is known as Mt. St. Helens—one of the oldest but most beautiful of the snow mountains.

Chapter IX.

THE OREGON COAST

THERE are a number of reasons quite aside from any practical considerations affecting navigation why the remarkable region of the Oregon coast should challenge our interest. First, it is the most active part of our continent. It is the place where the atmosphere, the hydrosphere, (ocean and waves) and the lithosphere (rocks and minerals) come into active conflict; second, it illustrates better than any other part of the earth one of the greatest facts in nature, that of constant change; third, if you study the coast seriously and are not content with merely gazing upon it, you will find the great principle of evolution, or development, very clearly demonstrated in the changes in land forms associated with the coast. And finally from its study one can gain a new realization of the magnitude and interrelation of the forces of nature, of the relation of cause and effect, and of many other principles which may be of help to one in formulating a stable philosophy of life.

In any discussion of the coast the climate is of vital importance, because many of the physiographic changes are the result of the cumulative effects of climate. The climate of western Oregon, and particularly the coast part of it, is typically marine, of the wet temperate type, and can be classified under the head of Mediterranean climate; that is, having rainy winters and dry summers with no extremes in temperature. Although at long intervals some particularly violent storms visit this region during the

winter, the weather is generally moderate. Frosts are relatively infrequent and not severe. As some of the coast features depend upon the direction of the currents and the winds (and in the last analysis the winds are the important factors), we should state that in the winter time the winds are generally from the southwest, while in the summer they are from the northwest.

It will facilitate our discussion if, at the outset, we give a classification of coasts in general. The following classification is a modification of one in use by Professor Douglas W. Johnson of Columbia University, an eminent authority on coasts.

There are four initial types of coast: one, a result largely of volcanic accumulation; second, coasts resulting from regional movements, such as mountain-making movements; third, those which results from faulting where there have been great ruptures in the geologic terrain, resulting in displacement of formations; fourth, initial coasts resulting from glacial erosion, such as fiords. An example of number one would be Yaquina head, near Newport; of number two, we may have a coast which has been rising such as there is in the vicinity of Brookings, where one may see great wave-cut platforms now elevated above the sea, with gaunt sea stacks standing here and there on them; or a coast of submergence where sinking has taken place, resulting in the drowning of river mouths. Coos Bay is an example. An illustration of a faulted coast is presumably, best illustrated by Neahkahnie mountain, with its bold cliffs. Here some of the valleys have been cut off by faulting, and have been left hanging in mid-air. We have no true fiords along our coast, but in the Tillamook bay region we have what the writer likes to call pseudo-fiords, or false fiords. Many of these valleys are now partly filled with alluvium and are being cultivated,

but they have a superficial resemblance to some of the Alaskan fiords.

The Oregon coast may be divided at Coquille river into two strikingly different subdivisions. To the north of the river, flanking the coast line proper, we have Tertiary sandstones, shales and some igneous intrusions, generally basaltic in nature, and overlying all of these, in places at least, fairly loose Pleistocene sands. (Tertiary and Pleistocene are relatively recent geologic periods). To the south of the Coquille river the rocks are much older, predominantly Mesozoic in age, highly altered and in many places badly disturbed with numerous secondary structures developed, which on erosion give interesting scenic effects. Another outstanding point in the development of the coast is the fact that the coast has been submerged to the north of the Rogue river; that is to say, it has been warped.

Before describing the geology and physiography of this, or any other coast, we must first consider briefly the agents that modify a coast line, but more important even than these is the nature of the materials to be found along the coast on which these agents work. We find hard rocks and soft rocks and loose sands that have not yet become rocks, arranged in various ways, having certain definite structures, which it is the business of the geologist to study.

Whether erosion is done by streams running into the sea, or by the waves, or by the winds, or by all combined, the principal structures to be found in the rocks have an important bearing upon the resultant erosional features. Although these structures are too numerous to explain, perhaps those most in evidence and easily studied are as follows: Bedding planes between the strata; contact lines; cleavage; faults, either large, or small which come under the general name of joints; folding; unconformities (a

special type of structure of technical significance) flow lines in igneous formations; *brecciation.**

The third important group of factors determining the resulting coastal features consists of the currents, both the shore currents and the tidal currents in and out of our estuaries, and the changing winds and waves. Even though one is not always aware of it, there is generally in one direction or another a very decided shore drift or current paralleling the coast. This is largely determined by the direction of the prevailing winds of the particular season. In the winter there is a definite northward movement; in the summer a southward drift along the coast. This current is moving the loose material along the coast with the help of the winds, and striking modifications take place from season to season such as the great spits projecting out from one side or the other of the bays.

The remainder of this chapter will deal with a few examples of outstanding geologic or scenic features on the Oregon coast.

The transportation facilities along the coast are most excellent. The coast can be reached from the interior by four railroad lines, and a number of good highways, crossing the Coast Range. But the Coast Highway, paralleling the coast, and in most cases running very close to the shore line, is the chief feature, in the matter of transportation, which makes our coast so accessible.

Nowhere else in North America can one find a first-class highway as long as this one skirting the sea so closely. There is nothing comparable to it north of the Columbia, and though there are some stretches in California which are just as fine, there is none so long. It may not be an exaggeration to say that, from all points which go to make

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*Crushed and often recemented.

for excellence in a highway, this is perhaps the world's premier example. It is hard-surfaced, 397 miles in length and of standard width and cost approximately $18,000,000. Originally it was called the Roosevelt highway, and one of the chief alleged reasons for its construction was to provide an additional means for military defense of our west coast, but so far, its chief use has been, and will be in the future, the transportation of thousands of tourists during every month of the year. Owing to the mildness of the climate of Oregon, it is never closed to travel, unless on very rare occasions for a few hours due to some local landslide.

For long stretches the highway follows the coast directly, even fighting its way around precipitous cliffs as it does near Neahkahnie Mountain, where it is nearly 600 feet above the sea; at other places down near sea level, paralleling some long sandy beach, or darting in behind a rugged headland, where one gets a chance to see the primeval forest with its almost jungle growth of rhododendron, salal, and other shrubs.

Small towns, inns, service stations and vacation camps are conveniently spaced along it, so that one is always in touch with civilization, and yet within hail of the forest and wilderness of the back country. If the writer were to choose a single natural feature of our state, he would place the coast, with the developments along it, as perhaps the most valuable economic and recreational treasure.

From a point several miles north of Brookings to the south of the state line, there is a very fine elevated coastal plain dotted with old sea stacks producing a very striking topography, which compels the notice of even the most casual tourist. This plain is some 10 to 12 miles long and about one mile in width and 180 to 200 feet above sea level. The sea stacks in the main are rhyolite (an acid type

of lava), varying from 100 to 150 feet in height. Everywhere this broad terrace shows post-Pleistocene (i.e. quite recent) dissection by streams in short V-shaped ravines and gulches. The town of Brookings at the mouth of the Chetco river is situated on this remarkable bench. Back from the sea a distance varying from one to two miles one can see the old shore line at the base of the rather abrupt slopes, which are old cliffs modified by erosion and creep.

The next point north of Brookings plain that we should call attention to here is Humbug Mountain, about six miles south of Port Orford. It is the only mountain directly on the Oregon coast approaching a true mountain in elevation. Neakahnie Mountain is 1250 feet in elevation, but Humbug, the southern one of these two is 1748 feet. Neahkahnie is due to the great resistant mass of dense igneous rock, whereas Humbug is made up from top to bottom of Cretaceous (i.e. quite old) conglomerate of igneous, waterworn pebbles and boulders finely cemented in an indurated sandy matrix.

This mountain is roughly conical in shape and much of it denuded of forest. At its base it is about two miles in diameter, but its crest is quite small in extent. The new highway follows the valley of Brush Creek, which skirts the eastern base of the mountain. All in all, this is one of the wildest and most interesting localities along this varied coast.

Since the state highway commission has recently acquired this as a state park, we should give it more than ordinary notice. There is still another reason, however, of more importance to the geologist, to take note of this mountain. High up on its seaward side at 1000 feet is the remnant of one of those marine terraces which, with the one on Bill's peak farther north, has left important clues as to the physiographic history of this section. There is

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State Hgw. Dept.

FORT ROCK, CENTRAL OREGON

ICE LAKE — WALLOWA MTS.

PACK TRAIN, WALLOWA MTS.

another one at 500 feet. At earlier times, geologically, this mountain stood out as an island on the coast and was much lower. With the rising of the coast, these wave-cut terraces are now far above the sea-level.

"*The Devil's Washing Machine*" is the local name for one of those exceptionally large vertical fractures, already referred to, extending nearly 100 feet into the country rock of hard sandstone. It is some 15 to 20 feet wide and the effect of the sea being forced into this cleft is fascinating to watch. At such a point as this we can see just how some of the fantastic shore features are produced. The force with which the water hits the inner wall at the end of the open fracture is tremendous, judging from the noise and the violent upshot of spray. It is nothing more or less than a gigantic hydraulic ram.

The *Bandon Rocks* are so well known to every visitor to the coast, because of their scenic beauty, that we shall mention them here in another aspect. These gaunt rocks standing out in the misty sea, which at twilight or in a heavy fog produce some weird effects, are remnants of the old wave-cut platform on Mesozoic rocks, chiefly Myrtle sandstones of the Cretaceous period, which extended farther out to sea and which the sea has cut into, producing arches and stacks and other well-known effects of coastal erosion which are of such great interest to people who visit this locality.

In 1775, a Spanish captain, Bruno Heceta, in command of a vessel named the *Santiago* (St. James) coasted up from Mexico as far as Cape Disappointment, which he called San Roque, at the mouth of the Columbia. The headland next south of Perpetua has been named for him, but we do not know who gave it this name. At any rate it is variously called Heceta, Heketa, etc.

This prominent and exceedingly picturesque headland

is made up of basaltic agglomerate and coarse tuff cut by numerous dense basaltic dikes. The dikes are usually from a few inches to three or four feet in width and have been faulted and off set in a number of places, but these displacements are inconsiderable. From the slope of the tuffaceous beds and agglomerates it would appear that the vent from which this material was erupted was only a short distance in the rear, i.e. northeast of the present lighthouse.

Just a little south of the Head, there are some remarkable caverns in the resistant basalt and basaltic agglomerate, produced by marine erosion along fractures or joints. Some of these are several hundred feet in length. One of these is the well-known Sea Lion Caves, which has three openings, two from the sea and one from above, by which the cave is now entered by means of a fine stairway. Sea lions come in from the open sea and sport around on rocks near the center of the largest cavern.

At *Newport*, probably the best-known place on the Oregon coast, there are at least a dozen outstanding geologic features which should be of interest to every one. We haven't time to describe them all but we shall mention them and give an explanatory statement of a few.

The best known scenic feature here is Jump-Off Joe, the famous sea-stack which is now in its dotage and just about to disappear beneath the sea. Some 50 years ago this picturesque rock was a part of the mainland. First, a little arch developed and then the rock was cut off finally from the mainland, but preserved the arch, and only a few years ago the arch fell in, and now a mere stump is left standing above high tide. In a few short years this will be merely a memory.

There are peat beds to be seen in the cliffs just above Nye beach. These represent old lake beds. One can see this

material forming in ponds and small lakes among the dunes today. This is coal in the making.

There are elevated beach sands containing gold, which with great labor can be washed out, yielding "better than wages" to the patient laborer. These elevated terraces mark old positions of the sea.

The agate beaches are the best-known features of the Newport area. Thousands and thousands of agates have been collected throughout the years and thousands and thousands of people come here annually to collect them.

Perhaps even more interesting than these are the fossils, both invertebrate and vertebrate. Many people have seen the little white blotches in the rock which represent the fossils of clam shells and snails of a former period. A few people have broken open some of the large, spherical concretions and have been rewarded by finding a perfect scallop shell or fragment of a crab or a small snail shell in the center. But how many know that in this same vicinity the paleontologists have found almost the entire skeleton of a prehistoric whale with very primitive characteristics, which was studied and described recently by Dean E. L. Packard of Oregon State College, and Dr. Remington Kellog of the Carnegie Institution?

Cape Lookout is to the writer's way of thinking the most scenically interesting place on the entire Oregon coast. It is not often visited by the tourist, because it is several miles off the main highway and one has to tramp for two and a quarter miles over the sand dunes after leaving the road. The Boy Scouts of Portland know this locality well. Their beautiful camp, Camp Meriwether, probably the finest Scout camp in the west, is located just south of this cape. The cape is a remarkable feature, nearly two miles in length, extending out into the sea at right angles to the coast, with cliffs 600 to 700 feet in height, almost

sheer. A great lava stream poured out of a vent in the back country and some of it ran into the sea. The record is still there, for the lower portion of the section is made up of "pillow" lava, a structure produced by the sudden chilling of hot lava under water.

One of the most striking features, geologically as well as scenically, is the bold cliff and higher eminence rising to a height of 1700 feet a short distance back, just south of Cape Falcon. This is the well-known Neahkahnie Mountain. The sea cliff here is almost sheer, about 900 feet, and looks very much like a fault scarp. The rock is igneous, in some places a rather coarse basalt, but exceedingly hard. Interesting legends might be recounted about "buried treasure" near this place but we haven't time for them now.

The new Oregon coast highway is cut around this cliff, some 600 or 700 feet above the ocean, giving a wonderful panorama of the sea and coast. There is a very narrow beach of hard round igneous boulders at the bottom of this cliff in great contrast to the usual beach materials.

And now our final illustration is the famous *Clatsop Spit* and beach ridges just south of the Columbia River. Extending south from Clatsop Spit to Seaside we have a series of long beach ridges. These remarkable features were first reported in 1849 by James D. Dana in the report of the United States exploring expedition under Commodore Wilkes. Dana mentioned three ridges, but recent work done by us in that region has revealed eleven of these ridges. In making an east-west profile through Dellmoor station, about a mile north of Gearhart, back to the foothills of the Coast range one finds this complete series. These ridges are made up entirely of sand and gravel thrown up like great waves. These vary in height from 25 to 50 feet above sea level and are in some cases

about 100 feet wide, much wider at the bottom than at the top. Investigation of this whole country-side indicates that these ridges owe their origin to the building of off-shore bars, which grew in height after the bar reached sea level by the addition of windblown materials, thereafter becoming dune ridges. The lagoons behind each have been filled to a greater or less extent by windblown sands, and so we have a succession of long, parallel ridges and intervening troughs.

We conclude from our studies so far that these ridges are due to aggradational processes rather than to a recent emergence of the coast. A rapidly emerging coast or even one coming up very slowly would probably produce the same effect. But at the present time, we have no definite evidence of elevation on this coast. In view of undoubted recent (geologically speaking) elevation on the coast, these ridges may have been partly due to the elevation and partly due to the work of shore currents as indicated above.

Space does not permit the discussion of many other features we should like to call to your attention. For instance, we should like to discuss the great contrast between this and the Atlantic Coast and the affect upon the life of the two regions, noting particularly the differences in the great development of coastal plain on the Atlantic seaboard and the almost total lack of this on the Oregon coast.

In closing this chapter we would fittingly end this brief discourse with these lines from the great poet of the sea, Masefield:

"And all day long the sea
Would not let the land be,
But all night heaped her sand
On to the land:
I saw her glimmer white
All through the night,

Tossing the horrid hair,
    Still tossing there.
And all day long the stone
Felt how the wind was blown;
And all night long the rock
    Stood the sea's shock:
While, from the window, I
Looked out, and wondered why
Why at such length
  Such force should fight such strength."

Chapter X.

GEOLOGICAL RAMBLES ABOUT NEWPORT ON THE OREGON COAST

IF THE tourist perchance has some other object in view than just merely to arrive at his destination, we would urge him to pause long enough along the way to read some of the interesting chapters in Oregon's great book of Nature, and particularly from that section of it revealed by the rocks and minerals, for many of these sandstones and shales represent beaches millions of years older than the present ones and the basalt columns in the cliffs along the road cuts represent ancient lava flows when Oregon was in the making. Crack open some of these lowly stones and oftentimes you will see the fragments of a fern or a tiny coiled shell which will bring to you the story of other days.

When you leave the highway at Corvallis and take the road to Newport, you are travelling at first over sandstones and shales laid down in the remote geologic period known as the Eocene. These sediments are gently folded beneath the Willamette Valley. On the eastern side of the Valley they are dipping beneath other beds of a higher group of formations belonging to the Oligocene, and farther on, beneath the Cascade lavas, but in the western margin of the Valley towards the Coast Range they are bent slightly downward to the west. Very soon you strike the foothills where road cuts and river sections reveal great intrusive masses of an igneous rock that is either

basalt or andesite, a somewhat less basic lava which worked its way up through large and small openings to the surface where, in some cases, it poured out on top in the form of flows. In others the material ran along between the beds of sediments forming what the geologist calls sills. The Coast Range itself is made up, for the most part, of flat lying or gently folded Eocene sediments cut through here and there by these volcanic plugs. Wherever you see a sharp hill, you may be fairly certain that there is a core of hard volcanic rock which has enabled it to resist erosion. As you near the west side of the range, you find the rocks suddenly dipping at an angle of 20 to 30 degrees towards the ocean, a series of them piled one on top of another like reams of paper, several thousand feet in thickness.

These shales and sandstones with their upper edges cut off are now covered over by very loose horizontally bedded Pleistocene sands. The best sections are afforded either by the river which has cut into the banks or by the new highway, where the cuts, of course, are man-made. If you break open some of the darkest of these shales you will notice tiny fish scales, and if you hold the freshly broken specimen close to your nose you will get a very distinct odor of petroleum. This fact has led some geologists to suggest that somewhere in that general region, providing favorable structures occur, such as anticlines and domes, there might be a suitable place to drill for oil.

Following the Yaquina river down to the beach, you find these sandstones and shales outcropping everywhere, but from the beach, you will note, if you scan the coastline to the north, that there is a great headland on which the Yaquina lighthouse is located. This great headland stands far out to sea because it is made up of a large mass of volcanic intrusion which is harder than the surrounding materials. It is a general rule all up and down the Oregon coast

that the headlands are made up of volcanic rock in large part, while all of the beaches and small re-entrants are located in the soft shales and sandstones.

Because the beaches around Newport are famous for their fine agates one is apt to hear the question, "How does the moss get in the agate?" Let me relate here the answer which the geologists gave to the tourist one afternoon while the two were basking in the sun on the warm sand. "Allow me to word the question the other way," the geologist said. "How does the agate get into the moss, or better, around it? You see it was something like this—but before I go too far I must tell you that there is more than one theory purporting to explain this thing. Away back somewhere in the mountains and "sometime" in the past, there were hot springs bubbling out of the rocks, just as there are in some places now. These are the last spasms of volcanic activity. The hot springs dissolved various elements and compounds from the rocks, the most abundant of which was silica (oxygen and silicon). Beside the little pools or perhaps in them (for we do see much the same thing in Yellowstone today) were growing tufts of moss, lichens, and algae. When the waters cooled some of the silica crystallized around the tiny plants and so preserved them."

The tourist was skeptical. "But are you sure it's moss?"

"There, my friend," the geologist replied, "is where you hit the nail on the head. That is the great question and there are certainly many specimens of "moss agate" which have no moss in them. In some cases it is only another mineral compound such as manganese oxide or perhaps iron which takes these fantastic shapes, but whether it be moss or manganese, the agate itself was once soft and gelatinous, even liquid, later growing hard and so encasing the foreign substance just as a twig may be caught in a piece of ice."

"Well, moss or no moss," the tourist interjected, "it is surprising how many attractive and even choice articles of adornment can be made from these stones which have hardly acquired the rank of gems. It seems that all Newport is given over to the business of hunting and polishing agates."

"But there is one man, at least, in the vicinity of Newport," the geologist replied, "who has a more precious mineral as the object of his search, and that is gold in the black sands. Come with me and let me show you something most interesting." He led the way along the beach, calling attention here and there to the abundance of black sand. They had edged their way through a narrow opening in the cliff and up onto a small bench about a hundred and fifty feet from the sea and yet completely hidden from the beach. Here they came upon the picturesque sight of a man at work with a shovel and "long Tom" which in mining parlance is a sluice-box.

"Well," the tourist exclaimed. "This looks like the days of '49."

"Or a character out of a long ago in southern Oregon," the geologist suggested.

But as they watched the "pay dirt" going into the sluice and descending swiftly over the riffle, about the only answer they were able to obtain from the old prospector was "Better'n wages." In the end it was up to the geologist to tell the tourist something of the origin of black sand as they walked back to the beach.

"The ruby sand consists of fragments of garnets, topazes, and so forth, while the black has particles of magnetite (the most common species) ilmenite, hornblende and rutile and other minerals, all once enclosed firmly in igneous and metamorphic rocks. When these decayed

through weathering, the minerals were turned loose to be concentrated by the streams or ocean waves."

Perhaps one of the most interesting things geologically is the *unconformity* about one-fourth mile up the beach where Dr. Thomas Condon, Oregon's pioneer geologist, used to lecture to large groups of the summer residents of Newport. An early picture shows the late President Campbell of the University sitting with others at the feet of the great teacher.

As this is one of the best examples of an *unconformity* to be seen anywhere one should not fail to note it. At a point where the rocks run out in a salient toward the sea the lower beds of sandstone and shale *dip* toward the sea at an angle of 15°-20° but in the upper portion of the pile the layers are *flat* and there is a sharp line separating the two; furthermore, the beds at the bottom are more compact than those at the top. What is the significance of all this? The bottom beds were once horizontal or approximately so and by *diastrophism* (movement of the earth's crust) came to be tilted up probably in a succession of folds; later erosion planed off the tops of these folds. This was succeeded by subsidence of the land when deposition of more sand and mud ensued and finally upheaval brought them all to their present position. The significance? An *unconformity* is one of the most important of geological phenomena, as it tells us much about land changes in the past. An unconformity has usually marked the change from each great geological period to another. The beds at the bottom of this Newport section are Miocene while those on top are Pleistocene.

In the upper layers of sand, but well below the top of some of the cliffs we note a dark band, which upon closer observation turns out to be a two-foot seam of *peat* or "coal in the making." Some day when Oregon's forests

are gone and her coal beds all used up, these peat beds will be a great comfort to our children just as they are to the people of Ireland today.

How is peat formed? The best way to answer that is to direct you to go a little way back behind the dunes into the rhododendron thickets where you can look into some of the shallow ponds. Perhaps you can read the answer then. What becomes of all the leaves, the twigs that fall into those pools? There is a part of your answer. The abundant Sphagnum moss growing in these swamps also contributes its share to the muck. After long years of compression in mountain making movements, these peat beds will be slowly transformed into coal.

Other geological features which the traveller to these parts should not overlook are the fossils in the rocks. If you look carefully, you will see many small marine shells which are firmly imbedded in the sandstones and shells resembling very much those living in the shallow waters today, but when studied specifically, they seem to be quite different from the living forms. Some of these genera with their scientific names (for some of them have no common ones, inasmuch as they lived long before man had appeared on the scene to give them a name) are: *Arca*, *Nucula*, *Glycimeris*, and *Acila*.

But still more interesting than these are a fossil whale and a fossil seal found on this coast in the Miocene beds which dip at an angle towards the ocean, the former, found by Dr. Earl Packard, at that time professor of Paleontology at the University of Oregon, and the latter by Dr. Thomas Condon, Oregon's first geologist. Both the seal and the whale are primitive forms in their respective family groups, being quite unlike their modern relatives. The seal has been called *Desmatophoca Oregonensis*. The whale has been named by Dr. Packard. Undoubtedly future

students and tourists working along this coast will bring to light other interesting fossils.

But don't forget to study the dunes as you go, for they are among the most interesting features along the coast. This is a world of change and you don't fully realize it until you study the shifting sand—wherever you see it, here on the coast, in the heart of Asia, in the burning Sahara it is pretty much the same creeping, crowding, resistless power. It has swamped forests, it has covered cities, it has crushed civilizations. Walk over the sand, study the multitudinous shapes it assumes, lie on it, get its smell into your nostrils, think of the myriads and myriads of tiny particles each moving but a short distance and yet hills are built up and tomorrow they are moved elsewhere. Try to stop them and they defy you; one might as well try to halt the passage of Time.

Chapter XI.

ON THE ROAD TO "BANDON-BY-THE-SEA"

IF THE traveller turns coastward from the Pacific highway (U. S. 39) at Junction City he will several times cross an interesting stream known as the Long Tom which is one of the best examples in Oregon of that particular type of river known as a *yazoo* stream, so-called from a tributary of the Mississippi. In a word this type of stream meanders parallel to the main stream for many miles before being able to break through the natural levees to join the master stream. The Long Tom, which in summer curves its way unostentatiously through the valley, often in winter, when it is over-fed by heavy rains, goes on the rampage and floods a great deal of the country. However, the flood days of the Long Tom are numbered for at last the geologist and the engineer have got their heads together to curb this winter outlaw and soon its waters will be controlled by a dam being constructed in the vicinity of Fern Ridge, a short distance northwest of Eugene.

After you leave the Long Tom basin you strike into the Coast Range in what is known as the Siuslaw country, and after following some smaller streams you come to the Siuslaw itself, whose region is one of virgin forests and few settlements. The river banks reveal the fact that the principal rocks are heavily bedded sandstones known to geologists as the Tyee of Eocene age with here and there intrusions of igneous rocks (basalt). The Tyee sandstone gets its name from Tyee mountain a few miles south in

Douglas County. The Tyee sandstone is interesting to us as a possible reservoir for oil if any oil is produced in the shales below, but to date no oil has ever been found by any geologist examining this formation. However, on the lower Siuslaw some years ago one geologist did report finding about a teacup of oil in a vug or cavity in a basaltic intrusion.

The region is one exhibiting sharp relief due to recent uplift of the Oregon coast province in which such streams as the Siuslaw are deeply incised. A stream of this kind cutting across the structure of the mountains is known as an antecedent stream, i.e. antedating the mountain uplift.

The present highway leads the tourist by one of Western Oregon's many beautiful lakes, which owing to its shape is known as Triangle Lake, a favorite spot of fishermen.

As you near the coast the railroad track and the highway swing to the south and you are soon traveling past a chain of lakes which are in the main, such as Tsiltcoos, old rivers dammed up by the sand dunes of the coast and hence are long and narrow. They afford unsurpassed sites for summer resorts and fishing that is particularly good. On one of these lakes, Cleawox, is the Lane County Girl Scout Camp.

One large river, the Umpqua, is crossed at Reedsport. The boat trip from this point up the river to the old landing at Scottsburg is well worth the time. However, a fine new highway makes the boat trip no longer necessary. Another side trip well worth the trouble is to Winchester Bay to dig clams.

Shortly after you cross the new concrete bridge spanning an arm of Coos Bay you come to Marshfield, the metropolis of Coos County, where you can see the beginnings of a great future industrial center and one of the future

great ports of Oregon. Whenever the east-west railroad line across the state of Oregon is built, and the dredging operations provided for by recent government appropriations are completed, Marshfield may be second only to Portland in this respect.

A side trip to Fossil Point only a few miles south of Empire is one every geologist and naturalist will want to take. Some fine clam shells, large scallop shells and a curious form called Crepidula can be collected here in abundance. The place seems to be one vast pudding-like conglomeration of shells, and this is one of Oregon's classic fossil localities.

After you have seen Marshfield, including its tremendous lumber mills, you can go on to Coquille, likewise a famous lumbering town. In the old days if you inquired of a young man on the street the name of this place he would reply, if sober, "Kokeel, sir," but if he were drunk, "Kokwell, b'God". Coquille is the French word for shell.

Perhaps you will be interested in the coal mines along the coast; the Liberty Mine at Riverton, or the much larger one at Beaver Hill. The one at Riverton turns out about 15 tons a day (when the writer visited it). Most of the coal in the United States comes from rocks that are much older—Carboniferous, as they are called. In Oregon the coal is comparatively young, belonging to that time known as the Tertiary. Strange as it may seem, the coal of Oregon is more like that of the Philippines and Japan than that of the Eastern or Mid-Continent coal of our own country.

The mine at Riverton is entered by a "slope entry" which is about one thousand feet long and inclined at least 20 degrees, so that at the bottom one is several hundred feet underground. The writer made the trip down several years ago and never before has he been in a coal mine

BOX CANYON OF THE OWYHEE BEFORE THE BUILDING OF THE DAM

SHORELINES OF FORMER CATLOW LAKE — S.E. OREGON

TEN MILE LAKE, OREGON COAST

Brubaker Aerial Surveys, Portland, Ore.

where he felt so ill at ease. In going down in the "tub" he had to lie absolutely flat and in walking about below he had to bend nearly double. In addition to the uncomfortable lack of space, the heat was almost unbearable.

From here you can go by way of the highway or river steamer down the Coquille River to "Bandon-by-the-Sea". Walk the beach at sunset for a view of the gaunt sea stacks that stand out from the shore at this point. Photography has done well with these beautifully wild rocks, but it will require a marine painter of the highest order to portray them adequately. Words as usual are a poor tool when picturing nature.

If perchance you happen to sight a full-rigged merchantman sailing by in the glow of the setting sun, your day will be complete. And should the sky be cloudless and the sea absolutely still you might be lucky enough to catch a flash of green just where the red ball of the sun drops beneath the waves—the spectacular "green ray".

In October 1936 Bandon was almost completely destroyed by a forest fire which resulted from the brush fires set by natives who were clearing their land. Plans for rebuilding the town along more modern lines are well under way.

If you choose to hike along the beach there are two routes which you may follow. One is along the sand spit where you must risk making the inlet at high tide; the other is farther inland by the road. If you take the beach, you must be sure to go at low tide when the sand is hard. It may be tragic if you attempt it at any other time. This part of the Oregon Coast reminds one very much of the coast of England and the opening lines of Locksley Hall:

"'Tis the place, and all around it, as of old,
The curlews call,
Dreary gleams about the moorland
Flying over Locksley Hall."

Soon one has to abandon the beach on account of the headlands and strike inland through the bracken and look for a trail or road along the bluffs, the main road being well back. After travelling for several hours you will come to the Sixes river. Here, near the mouth, one may spend the night at Hughes' ranch, finding every comfort and refinement in a region said to be the wildest part of the United States.

Cape Blanco, the farthest western point of Oregon, is just ahead. During the war no one was allowed on the reservation of the lighthouse, but now it is open to the public. Here is an *unconformity* much like the one described at Newport, but in this case it is between the Pleistocene and Pliocene and the Cretaceous. The most remarkable feature in the topography of the coast near this point is the elevated marine cut platform, which is nearly two miles wide. About 175 feet above sea level in the topmost beds one will find a mass of clams in the process of petrifaction. These shells are almost identical with live species along this coast, and, therefore, the lesson naturally to be drawn from them is that this coast has been very recently uplifted that amount. Among the many interesting species was one, the giant clam (Saxidomus giganteus).

Not far below the lighthouse you should come across some men sluicing the beach sand for gold and platinum. Such was the case when the writer made the trip several years ago, and this was the manner of their work: a gasoline engine furnished power to turn a chain of paddles, the lower end of which dipped into an artificial pond of sea water, bringing up a steady stream with which to sluice

the sands. One old miner panned out a shovelful of black sand for us and showed us a fine lot of "colors" of gold and platinum. An old device for recovering gold and platinum, now abandoned, can still be seen half buried in the beach sands.

We should remind the reader that the bulk of the world's platinum comes from Russia, and Colombia, S. A., and that in only two or three places in the United States is any commercial platinum recovered, and of these places the Oregon beach produces the most, in some years running as high as 100 ounces. Although this doesn't seem very much, remember that platinum is at times worth three or four times as much as gold.

Chapter XII.

THROUGH THE ROGUE RIVER CANYON WITH A KNAPSACK

IF ONE continues along the Coast Highway which follows for a long distance the bluffs overlooking the sea before it passes inland through the timber and out again serpentining around bold headlands and past swamps full of wild flowers, he finally notes in the distance innumerable small rocks on the beach which indicates that he is nearing the mouth of a river—in this case the Rogue River guarded by the two little towns of Wedderburn and Gold Beach. The whole countryside now has a California aspect. All is sunshine and there is a blueness that one associates only with the southland. Even the sky seems different from that of Oregon.

Many of the foothills along this stretch of coast have a peculiar "slumped-down" topography and are generally bare of trees—even the smaller vegetation is different and the soil is quite red. Occasional bluish-green patches are seen on prominent noses in the topography. All those, to the trained eye of the geologist, are signs of serpentine formation, one of the important kinds of metamorphic rock in the region. Serpentine is an altered peridotite or pyroxenite (two basic igneous intrusive rocks) and is the home of the important industrial mineral known as chromite which during the Great War was mined in Oregon, but since that time has not until recently had a market.

It is used in hardening steel for tools and latterly has come into great prominence in the production of rustless iron and steel.

The platinum on the beach which we mentioned in an earlier chapter must have come from the same sort of rock which has yielded serpentine through metamorphism. In fact there are several interesting minerals and geologic products in this region which we can only mention in passing as our space doesn't permit any lengthy discussion of them, but we should not overlook the curious and rare nickel-iron mineral, Josephinite, from the gravels of Josephine Creek primarily, which has been found in several places along the Rogue River. The mineral is dull silver-colored though tarnished on the weathered surfaces, and rather heavy. It is one of the very few sources of terrestrial iron, though it does not occur in quantities to be economically important. It may be of meteoric origin.

From Gold Beach one can continue southward by the completed highway to Brookings and on to Crescent City, or take the trail up the Rogue River through the canyon until you strike a railroad and highway again about 100 miles east.

As the Rogue River is one of the most remarkable streams in Oregon and historically one of the most important in the Northwest, it will pay us to make the trip. It is the finest river scenery the writer has seen in Oregon; in fact it is said to have one of the most scenic canyons in the United States.

Its historical interest rests particularly upon the fact that soon after the days of '49 great numbers of Californians came to southern Oregon looking for more gold. The origin of the gold of this region is interesting because it was washed out of gravels of ancient rivers dating from that period of geology known as the Cretaceous, and many

of the best gravel deposits are on benches far above the present river channel. In 1857 over $20,000,000 in gold was recovered in Oregon, mainly by panning and sluicing; and a great deal of it came from these deposits in the Rogue River country.

Geologically, the Rogue River is another of those *antecedent* streams which rise far back at the summit of the Cascades and are very old.* It has continued to cut its way across rising folds of rocks which came up gradually in its path. Some of these formations are quite old and have been profoundly altered. One of the most prominently developed being argillites, a slaty rock which once was mud on the sea bottom. Others are *schists,* a foliated rock which presumably also was a sediment of some kind. These are cut through by large and small veins of quartz and calcite in which some gold also is included. The erosion of these has released some of the gold which now is found in placers or stream deposits.

The first part of the trip through this canyon, when the writer first traversed it, was made with a boat propelled by a small Evinrude motor, which, however, was useless when we came to the riffles or small rapids. There you will have to use poles, and in some places you will have to jump out and pull your boat through. After you have done this all day, your camp supper and coffee will taste better than a king's banquet.

The old Indian trail which once followed this canyon, sometimes at dizzy heights far above the river, was most fascinating. This is now supplanted by a fine forest trail, which winds through the canyon on a fairly even

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*Antecedent stream is one whose course was determined in an earlier cycle and has maintained its present course regardless of obstructing barriers.

grade. There are convenient stopping places with white homesteaders and half-breed Indians, which are fairly good in the matter of accommodations, though the pleasantest way is to camp out.

At one place on the trail there is a side stream joining the main river by a series of ledges and falls having the appropriate name of the "Devil's Stairway". Usually such interruptions to the even fall of a stream, rapids and falls, are due to dikes of igneous rock which because of their greater hardness protrude from the softer rocks which they cut. There is a great deal of this kind of rock in this canyon. In the bottom of the pool at the foot of this "stairway" you can see large black objects which, from the trail several hundred feet above, look not unlike railroad ties, but if you look sharply you will see that they move. They are steelhead salmon. You may not wish to believe this story, and so will have to make the trip through the canyon to confirm it. In fact if you never have placed yourself in close harmony with a slab of fresh red salmon all hot and juicy from your camp fire, as the darky would say, "Yo' ain't neber had no fish at all, atall!"

As you travel along you will soon be struck with the wide, red gashes in the side of the canyon. These are the marks left by the ruthless hydraulic miners of early days. In the tropics the ripping and disembowling of old mother earth by these giant streams is soon covered over by rank vegetation, but here in Oregon where the vegetation is not so dense, many of these wounds are gaping and raw still.

There are no longer on this river the giant monitors with which the miners used to go about winning the gold. You will have to go to some other stream, perhaps the Illinois or into California where they still use this method. In brief, the water was taken from the stream at a higher

level or from a reservoir or small lake, and often brought many miles around the hills in strong wooden flumes or in iron pipes to the monitor which resembles a giant fire hose. A powerful stream of water, depending upon the *head* or elevation of the intake above the monitor nozzle, is turned upon the gravel bank, cutting and ripping the long cemented gravel. Then the boulders, gravel, sand, clay and gold are washed down into a long sluice box lined with riffles, coconut matting and wire screens, devices for checking the velocity and causing those little eddies so important for catching the gold before the turbid stream flows out at the far end.

At intervals the miners made a "clean-up", recovering the amalgam, as a result of the gold and previously placed mercury. By retorting, for example, sublimation of the mercury, the gold was recovered pure and the mercury vapor after condensation was used again.

The motorist may regret the fact that he cannot take his automobile through the canyon. He may reach it easily at either end by car but the two or three days between must be done under his own power (or that of his *caballo*),* for this is one of the few places left in the world where all travel is done on "shank's mare", or horseback. It is advisable not to attempt the trip in late summer because that is often the time of forest fires, and the combination of the August sun and the heat and smoke is unpleasant.

One of the principal tributaries of the Rogue is the Illinois which comes in from the south. At the junction of those two streams is the settlement known as Agness. Some interesting characters among the mining population of this remote part of Oregon are to be met here. One of those

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*Spanish for horse.

who was prominent in mining activities in this region in the early 1930's gained considerable notoriety through a peculiar and distressing accident in which he had the misfortune of losing both hands when an old shotgun which he was handling went off. This resulted in one of the most sensational insurance suits this state has ever had.

When the traveller emerges from the canyon at Merlin, he is in the heart of the old Klamath Mountains in the land of the Siskiyou, one of the two ancient islands named by Dr. Condon. Here he comes again to the railroad and highway, to the towns and orchards. He will be glad to have rest and the creature comforts that go with civilization, but all through the years he will recall with joy those cliffs, the quiet pools, the wind in the forest trees, the reds and greens of the rocks and of the soils of the Rogue River Wonderland.

Chapter XIII.

THE OREGON CAVES

OUR next trip of exploration will be to the "marble halls" of Oregon, one of the most interesting natural features in this state, so replete with outstanding scenery. Although these caves do not compare in size with some of the famous caverns of other parts of the United States, they are perhaps the most extensive on the Pacific Coast.

It is pertinent here to say something about caves in general; first, as to their importance to early man and next with reference to science. Nearly everyone is aware that primitive man, in certain parts of the world at least, has made use of rock shelters of one kind or another. Some of these have been merely over-hanging cliffs, such as we find in the southwestern part of the United States in the Mesa Verde National Park; but many of them have been caves where men could penetrate some distance under ground and find a safe haven from storms and wild animals. Even today, many people in southwestern France live in limestone caves. The most famous of the European caves which afforded shelter to primitive man is the Altamira Cavern in northwestern Spain close to the Pyrenees. On the walls of this cavern are still preserved some of the finest works of art of the primitive man.

Caverns are of great interest to certain scientists, particularly students of paleontology and of the pre-history of man, since many bones of extinct animals, some of prehistoric humans, have been found preserved in caves. One

of the most interesting of these finds are some human artifacts associated with the excrement and bones of the extinct sloth in Gypsum Cave, Nevada. Another famous cavern, or series of caverns, are the Cheddar Caves near Bristol, England. These contain skeletal remains of men presumably 50,000 years old.

While as yet no important finds of Pleistocene or other bones have been found in these particular Oregon caves,* it would be well for anyone exploring these caverns to be on the lookout for such material, and on finding anything of this kind to get in touch immediately with the geologists at the University or the State College as these finds may be of great interest to science.

Some of the most famous caverns in this country are the Carlsbad Caverns in New Mexico which were discovered in 1922 by a member of the United States Geological Survey; that is, the present large chambers which have attracted so much attention, though caves in that general region were known long before. These caverns are probably the largest in the world.

Then we have the Mammoth Caves in Kentucky, long known to the public; also the Luray Caverns in Virginia. Among the most beautiful caves in the world are some in limestone at the head of the Adriatic Sea.

Let us look for a moment into the interesting subject of how caves are formed. We have three principal types of caves. The commonest are solution caves where groundwaters, working throughout the ages have dissolved great masses of lime carbonate leaving cavities. Caves are very common in limestone regions, and the largest caves are in-

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*Since this was written important archeological and paleontological discoveries have been made in certain lava caves in the eastern part of the state by Dr. L. S. Cresman, professor of Anthropology at the University of Oregon.

variably in limestone. Some regions are so honey-combed by these caverns that they have the characteristic sink-hole topography on the surface. Such regions are dangerous to traverse. The region east of the Adriatic Sea in Albania is notorious in this respect.

A second type is a lava cave. We have some fine examples of these in Oregon. Some are quite irregular in size and shape and are merely great blisters due to expanding gases; others are lava tubes where the hot molten rock ran through the outer, cooler portion leaving great sewer-like cavities behind. These are generally smooth-walled and as a rule have few or no pendants from the roof. Often they have ice in the bottom of them as in the Ice Cave near Bend and in the caves of the Modoc lava beds southeast of Klamath Falls.

A third type of cave is entirely man-made as the rooms carved out of the great aeolian deposits (wind-blown) known as *loess* in northwest China. Many thousand people live in such man-made caves.

It is now time to say something more particularly about the Oregon Caves. These are found in a bluish-gray marble formation which extends across country from the Applegate River beyond the California line. This is merely an altered series of limestone beds which dip at an angle of approximately 45 degrees to the southeast and which strike, or trend, in a general northeast-southwest direction. These limestones were deposited in a very ancient sea, probably as far back as the Paleozoic era. Later there was a period of mountain making during which the limestones were changed into marble. In this folding and buckling of the earth's crust in these parts, there was a profound fracturing of the rocks. These fractures have definite directions along which the ground waters have since percolated, dissolving out the material, giving us

the chambers and passageways we are now able to traverse. The waters have deposited a part of their dissolved material through evaporation, giving us fantastic forms of encrustation. Some of these are pendants from the roof (stalactites), while others are accumulations on the floor (stalagmites). The largest chamber in the Oregon Caves is known as the "Ghost Chamber". This is large enough to assemble, by crowding a little the congregation of an average church. The most interesting and spectacular is the chamber known as "Paradise Lost". Here the fantastic stalactites and stalagmites, set off to the best advantage by means of a system of colored lights, always excite the admiration of visitors. Other noteworthy features are "The Beehive", and the "Dragon's Mouth", "Niagara Falls", the "King's Palace" and the "White House". These are all varying, fantastic formations of calcium carbonate encrustations due to deposits from the underground streams.

The late Ira A. Williams, former geologist at Oregon State College, once wrote the folloging paragraph in a longer account of these caves: "Water is the agent by which the healing process is carried on. It dissolved in places of plenty and transports to points of weakness, where it skillfully applies layer after layer, as a soothing lotion on an open sore. The jagged surfaces of rough rock walls are coated over, furrowed ceilings are smoothed out, floors harmoniously carpeted to match. In some places pillars rise from the floor or drop from the roof as though temporarily to steady a precarious span. And it seems to be characteristic of the manner in which this agent of restoration works, that there will be found at almost any stage the most exquisite surface finish. Ceilings and walls are frescoed with well-nigh unwarranted elegance; alcoves, balconies, and corridors are fringed with the most immaculate draperies, floors silk-lustered and never meant

for the tread of feet. Ever dissatisfied, it seems with the results obtained, a fresh coat is put on, and then another, each differing from the one it covers up—not in substance, but varied in design infinitely or infinitesimally as the case may be."

If you have never been underground in a mine or cave, you have a real treat ahead of you. Let us do this now. Let us imagine we have had a good rest at the chalet and a tip-top breakfast and are ready to leave the chalet. The first thing to do is buy a ticket at a nominal price at the office. Then we join a group of others who are going to make the cave trip. We are given cover-alls to protect our street clothes and are advised to wear stout shoes. As soon as we have about a dozen gathered together we are ready to go but must wait our turn. The parties are run through on regular schedule and at definite intervals apart. Soon a guide, generally a young college student, supplies each one with a carbide lamp and gives the group a short talk at the cave entrance. Then you leave the warm sunshine and enter the mysterious underworld.

At first you are somewhat awed by the dark passages and fantastic, even grotesque scenery, of this new world you are exploring. After a short time you become used to the unusual surroundings, your nervousness subsides and you begin to see all sort of beautiful figures. You travel some distance on a level and then climb slippery ladders to some enchanting chamber above. Once in a while it is necessary to dodge a stalactite, or squeeze around a marble pillar. Here you stop beside a subterranean pool, and you hear the tinkle of gently falling water, but you hear no sounds of birds, no rustling of forest leaves, only the exclamations of your companions or the drip of water.

On every hand are columns, balustrades, chandeliers, minarets, altars, and so forth, all sparkling with myriads

of reflections from subterranean lights. If it weren't for your guide you would be completely lost in the maize of passageways.

Two interesting exhibits, besides the witching tracery on the ceilings and walls should be noted. There on the roof of one of the chambers is a real carrot hung there some two years ago, quite preserved in the cold storage atmosphere of the place.

Over there in another place you can see a root of one of the trees growing above the cave. You are forty feet below the surface, and here you see what this tree has done in extending one of its roots down through tortuous crevices in an effort to reach water. Finally after about two hours of travelling, stopping for an occasional "breather" or a bit of story telling by the guide, you enter a long man-made tunnel which leads you out to the surface again and you stand for a moment blinded by the dazzling light, thankful to be in the open again but with a longing to return to that fairy land of perpetual night. You have become a little chilled perhaps in that region forever deprived of the warm sun and you have a renewed respect for that great shining orb overhead, that giver of light and warmth to mankind.

The Oregon Caves were discovered in August, 1874, by Elijah Davidson while bear hunting. Joaquin Miller, the poet of the Sierras, who formerly lived in Oregon, describes the discovery as follows: "His nephew who, then a lad, was with him, told our party by our camp fire that his uncle shot a white-faced black bear not far away, that the dogs chased it to within a few rods of the main entrance, that they then killed and dressed the bear and that his uncle, a close observer, as all hunters are, seeing the beautiful stream at hand and yet seeing no hollow or draw from which it might flow, followed it up to the debouche-

ment, and striking matches on the wall followed up the stream so far as he felt safe."

About three years after the discovery, Frank M. Nickerson of Kerby, Oregon, further explored the caves, at that time finding four different floors or levels. In April, 1903, a large portion of this part of Oregon and California was withdrawn from entry to settlers, and the caves became a part of the Siskiyou National Forest. Only recently the Caves have been transferred to the National Park system and they are now administered by the Superintendent of the Crater Lake National Park, as a National Monument.

At the present time the Caves have been highly developed, by means of ladders, lights, enlarging passageways, and in providing accommodations for travellers in the fine chalet near the cave entrance. This chalet is built in the rustic style and all the landscaping about it is in harmony with the wild background of this rugged country.

In closing I would mention the names of two men who, perhaps more than any others, have had to do with the development of the Oregon Caves. One is the veteran guide, Dick Rowley, who for nearly a quarter of a century has been guiding people through these caverns. It is a treat to go with Dick Rowley through "the marble halls" of Oregon. No one else loves the caves and knows them as does Rowley. He knows their history, how they were formed and can tell you many interesting stories connected with them. The other person I wish to mention is George Sabin, manager of the Oregon Caves Company, which administers the chalet and looks out for the comforts of the tourists. George Sabin* is a genial host and has earned the enviable reputation of conducting what is perhaps the best run resort in the entire state of Oregon. In these days

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*We regret to record the death, early in 1940, of our good friend.

when there are many concerns which are just hoping to get by and make a big profit, it is a pleasure to find excellence of an unusual degree such as one finds at the Oregon Caves. The evening entertainments provided at this resort are not surpassed at similar resorts anywhere within my knowledge. If the tourist wants the interesting experience of travelling far underground in caverns perhaps "measureless to man", likes a quiet evening of music and stories by an open camp fire, and then all of the creature comforts at moderate cost that go with a tavern run by experts, this is the place to visit.

Chapter XIV

KLAMATH LAKE

WE ARE rolling southward to Klamath Falls on the Dalles-California highway through the stately Ponderosa pine forest where for long stretches the road is so straight and so smooth that we are in danger of being lulled into slumber. Here and there rude piles of broken rock come into view on either side of our line of travel. These appear to be and are great blisters on the back of Mother Earth and are good evidence of the volcanic fires that built this vast lava plateau. Occasional clearings in the forest or open mountain meadows afford one a wonderful panoramic view of the distant skyline of the Cascades on the west which at certain times of the year include a half dozen snow-capped peaks. In the early morning or late evening one may surprise a deer or two who sometimes stand for a split-second, picturesquely high-headed before darting off into the forest. Or at night one may hear the peculiar yapping of the coyote before he starts on his nocturnal hunt.

It is interesting to note that in places where junipers displace the pines the surface of the ground is covered with a light yellow pulverulent soil. If you take the time to examine this you will find that it is pumice, froth-like spewing of some distant volcano. Some of this came from the Paulina craters to the eastward, some of it from old Mt. Mazama to the southwest.

As we drive on southward the country becomes more

hilly and the road more winding and soon we are following great scarps of dark grayish to black basalt. Here the geologist will explain that rifts in the earth's surface have occurred and enormous blocks of terrain have settled down producing *faults*. At Modoc Point one may see where the earth has actually slipped and where the highway has cut the smoothed grooved fault plane.

As we begin to leave the high country we behold on our right a vast, sunken area, the Klamath basin—more technically called a *graben*.* Streams have filled this area with some debris and also water. From here on for miles and miles the highway skirts the shores of one of Oregon's largest and most beautiful lakes. If you have time to stop here and wander at the edge of the water and dream for a while in the warm sun you will see innumerable birds—in the tules, riding the crests of the small waves, flying in almost rigid formation against the blue skies. Above you may watch a squadron of white pelicans, definitely more graceful in flight than on land or water; below on the surface of the lake you may be amused at the business of a dozen drab little "mud" hens. Down the shore you catch a flash of bright color against the tules and identify a blue heron. If you will allow your mind to slip from the fast-moving present you may even conjure back a bit of the past and see this lake when only the Indian inhabited its shores, reconstruct in the mind's eye those pile-built (perhaps) villages, hear the Indian love song over the quiet waters. There! Was that a dugout canoe you saw push out from the bank?

Off to the westward our gaze wanders to a majestic cone, Mt. McLaughlin, the most symmetrical volcano in all the Oregon country. Once its rumblings and belchings

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*A down-dropped trench-like area.

sent the red men scurrying in terror into the forest or some cave. Now it is sleeping and no man fears it.

Let us stop for a while at Klamath Falls which is situated on the short Link river that connects the Upper Klamath Lake, which we have just passed, with its lower lake. The Indians used to call this lake Aka-ushkni E-ush.

The chief industries supporting this progressive eastern Oregon city are lumber and irrigated farming and dairying. Just what will happen to this place when the lumber is all cut off is hard to predict. Will it become another ghost town like some others in the Pacific Northwest? We hope not.

One of the most interesting trips to be made in the nearby country is that to the famous lava beds just across the line in northern California. I visited this many years ago with the most famous citizen at that time of Klamath Falls, Captain Applegate, who showed me over the battlefield of the Modoc Indian War. This is a national monument now and has been described by many writers. Captain Applegate and I sat down on a rugged blackened mass of lava and I listened to his thrilling account of this battle which took place when he was a youngster. When he recounted these happenings to me he was nearly ninety.

On the way back to Klamath Falls we visited one of the interesting geological features of that region, a lava river tunnel which, although situated in the hot desert country, has ice in the bottom of it. These caves which remind one of giant sewers were formed by hot molten lava streams that ran underground beneath the congealed overlying crust. I visited a similar one in Hawaii some years later, but instead of being cold like this one, it was steaming hot, for the molten lava was only a few feet below.

Another scenic trip from Klamath Falls is to the Lake

of the Woods on the slopes of the Cascades. And of course one must not forget that Crater Lake can be reached in a short time via a fine paved road.

Chapter XV

HART MOUNTAIN AND THE ANNUAL ANTELOPE ROUNDUP

"Oh, give me a home where the buffalo roam,
Where the deer and the antelope play;
Where seldom is heard a discouraging word
And the skies are not cloudy all day."
—*Home on the Range.*

ACROSS the great open spaces from Klamath Falls moving eastward, unlike earlier wagon trains headed toward the setting sun, winds a motor caravan of young, old men, and some not so old, out toward the rising sun coming up over the shoulder of Hart Mountain. These boys in their low-slung (too low for high centers on the high desert) modern cars are going out in search of antelope, so they say, but really in search of their lost youth—hoping to get one or two more fleeting thrills and some adventure before settling down to the "slippered pantaloon" years and the final curtain call.

We'll not stop to tell you of the old wild ride through the "Devil's Garden" (before the new highway construction) and the Mule Deer Game Preserve, the hustling frontier town of Lakeview, a bit of the old West, but we should pause long enough to mention Oregon's only geyser. This is situated at the Hunter Sanitarium just three miles north of this town. Carl Williams, a former geology student at the University, drilled a well on this site a few

years ago and "believe it or not", he brought in a hot water geyser which functions intermittently as all well-behaved geysers do, today. The sanitarium uses this hot water for heating and for hot baths.

Lakeview is situated at the foot of a great fault scarp produced by a major fracture in the earth's crust along a north and south line. The hot water comes up to the surface as a result of this fracture. Also, earthquakes sometimes occur as a result of slipping along this line of weakness. Though these disturbances are not particularly severe they are at times somewhat disturbing to the equanimity of the inhabitants, as witness this episode of a few years ago as related to me by an eye-witness. It appears that three men, a school principal, another citizen, and the only Japanese in Lakeview were playing billiards—our Japanese friend was just about to shoot when suddenly the three balls leaped into the air. When the son of Nippon saw this he yelled, "Glee Clist" and dived through a nearby window taking a part of the sash with him! The game was not continued that evening.

The trip over the mountains east of Lakeview is very fine, but we must not linger on the way but get on to our destination. As we coast down the long grade from the high plateau southwest of Plush we see evidences on every hand of much more water in this country in former times and when we come to the sudden descent into that little way station we go down over a remarkable old delta on the edge of the former great Warner Lake which once was 215 feet deeper than the pitiful remnants there now. The Warner Lakes there today are quite shallow and greatly shrunken from their former status and lie in the bottom of a great trench, called by geologists a *graben*. On the west side are some low escarpments, but on the east side of the trench rises a stupendous wall of basalt

many miles in length and several thousand feet high. This basalt escarpment has one part which reaches 8030 feet above sea level. This high point is Hart Mountain, named after Hart Ranch, a misspelling of heart by the *vaqueros*. A heart-shaped brand was used here. This is the story according to the eminent authority, Lewis McArthur.

The road from here on is hewn out of solid rock and has "switch backs" to enable it to get over the north shoulder to the High Desert beyond. Back on the east side of this eminence is the antelope country and what a country! This is the place you read about, but only see once in a lifetime, and some never will lay eyes upon its magnificent panorama. The country is "high, wide, and handsome" and there is no limit except the clear eastern Oregon sky. Whoa! steady there—what is that silhouetted against the eastern skyline? Your heart misses a beat and then goes faster as the small objects leap away over the lava blocks. There they go, not one, but hundreds of them, marvellous pieces of animal machinery—dashing away into the evening haze—antelope—why try to describe this sight? It beggars description. You must see it. You must feel and smell such a scene.

Well, you resume your journey down to Merle Jacob's cabin beneath the brow of the hill. Merle Jacobs is the Government hunter and trapper of predatory animals who knows this country as no one else in this great wild eastern Oregon.

From north and south, east, and west, by all the roads from everywhere, the autos come to the Antelope Round-up—men from all walks of life and after a big barbecue "feed"; they have an unusual camp fire program—I really would like to let you in on this wild ceremony but I might be expelled from the order if I divulged its secrets and

the chief "keeper of the prongs" might conceivably order the amputation of a prong!

The camp fire dies down, the moon rises over the eastern rimrock and the coyotes start their part of the program—but wait, we are not ready yet to lie down in peaceful slumber, for a doctor from Klamath Falls is uncertainly feeling his way over and around the prostrate forms rolled up in their blankets in the grass. He stumbles along and finally pauses and looks down at the half enclosed face of a snoozing brother. This brother has a well-developed goatee and some whiskers—the doctor yells out into the stillness of the night, "Ho, what have we here? Well, I'll swan! It's either a porcupine or a PhD!"

Chapter XVI

THE COUNTRY THAT OREGON AND GOD FORGOT

THE old Mexican arrastre* swung slowly and steadily around high up on a bench at six thousand feet elevation on Pueblo Mountain, down in a corner of Oregon near the Nevada line. On a rude seat sat an old man clucking and talking to an old white mare. Exactly when the shadow of the center pole reached a certain point—noon—the old mare stopped and whinnied. Slowly the old man got up from his seat and unhooked the mare, and after hobbling her, turned her out to graze on the mountain side, then he turned to us and said:

"Well, boys, have you come up to see what the old man's got? I'll tell you, if you don't know it, you're goin' to see the equal, or better'n th' Comstock. (The world's most famous silver bonanza.) Had a pretty stiff climb up from the valley, didn't yer? Didn't expect to see an old man like me peckin' way up here now, did yer? Well, just make yerselves at home a bit till yer git yer breath and I'll show yer the "Raven" and the "Mountain Pass' ", indicating two claims above us on the higher slopes. Such was our greeting from the most interesting character and the oldest resident in that part of the state. The old prospector stood before us in the true garb of the

*Primitive type of gold mill.

"sourdough", and not in the habiliments of the miner as depicted on the side of Alber's Flapjack Flour package. As he talked, his eyes watered, partly from weakness due to age—something over ninety—and partly from the effects of his smoke-filled stone hut, and the dry desert wind. We stood face to face with a bygone chapter or series of chapters of Oregon's and the nation's early history—the time of the "Covered Wagon".

From where we sat we could look off across the Alvord Desert toward the Jordan Valley and the great block mountains of eastern Harney and Malheur counties in the extreme southeastern portion of Oregon. We had come more than five hundred miles from the pleasant fertile valley of the Willamette out into this wilderness of lava rims and dried-up lakes to seek new data in geology and thrills in scenery, and here in a land of tremendous geological interest we had come across the most interesting thing in all the world of strange and interesting things —man himself. Here within sight of this lonely man of the hills roamed bands of antelope; within his hearing there was the bark of the coyote pack; on the crags above screamed the fast vanishing eagle. In the midst of this wilderness stood a man who seemed to have stepped down out of a past century—in fact, he had.

It should be stated before we go any farther with our story that the so-called Great Basin of Western America covers most of what we know as Nevada and Utah and extends up into south central Oregon. It is a land characterized by interior drainage, i.e. there is no outlet to the sea, and mountain ranges generally of the fault-block type partially buried in alluvial wash, salt lakes, and playas, or dried-up lake beds, are common. A fault is a technical term indicating a break with a displacement between two blocks. Though much more extensive bodies

of water formerly existed here, now it is a region of greatly reduced rainfall. Many of the tilted blocks are capped with lava. In the bolsons or intermont basins are salt deposits and sand dunes. Many of the streams disappear in the sand soon after they reach the lowland areas. The geologic structure of the region most characteristic is the so-called *graben*, or elongated trough-like depressions between uplifted blocks. Facing these depressions are steep escarpments of several thousand feet while away from these the tilted blocks have rather gently dipping back slopes. The Warner Lakes, Abert, and Summer lakes occupy such depressions. Similar structures known as Rift Valleys are found in East Africa in the region of the Great Lakes on that continent. The scenery of the eastern Oregon region is comparable in every way to that in East Africa.

In the gratifying shade of a projecting spur of the hillside we smoked a restful pipe or two while the old-timer with only a little prompting dipped back over half a century into his own history and told us some of the episodes of the plains and of the mines which have never yet been published.

"You know, boys, I can't do as much as I once could; my old back is not as limber as yours. What I need is men, *young* men and iron, and then—well, say—it'd beat the Comstock." But the desire to talk about the old scenes, "old unhappy (and some happy) far-off things and battles long ago", took possession of the old man and the words flowed on unchecked by us. "You see, gentlemen," (once in a while he became more formal) "I've just got to talk—for days and months it's just me and the mare and my old tomcat, and I get a bit lonesome—I *must* talk."

And as he talked we pictured the great emigrant trains heading for the west, we heard the warwhoops of the

bloodthirsty Indians, and knew that it was not a movie performance this time. We were getting it straight from one who had been a part of it.

After a while I ventured to remark how sturdy he was for one of his years and asked him for his panacea of health. His reply I might have anticipated in substance, but not in the way he said it.

"Oh, it's simple. Just keep busy and watch your bread basket. You must be good to yer bread basket; if that gives out yer ain't got much. I don't eat much—today just a flapjack and a dipper full of beans."

Later on in the afternoon we sat in front of the old "sourdough's" stone and sod house, half dugout, half house, in which there were no windows—all smoke-begrimed inside—and continued our talk of ores and men, and long past events. Just as the long shadows were enfolding us and the chill of night was creeping down from the heights, the old fellow said, "Wish you could camp here awhile, boys. I get mighty lonesome sometimes. If you'll stay I'll give you a good claim—a claim that'll beat the Comstock—yes, sirs, better'n the Comstock."

The old man almost whined at us as we bade him goodbye for our trip down the mountain.

"So yer headed toward old Steen's Mountain, be yer? Well, they ain't no mineral on that mountain. Nothin' but rocks and sheep and a few Bascos."

After a last look back over the shoulder at the old man there with his two sole companions, the old white mare and the coal-black tomcat, we slipped down off the mountain. Slipped is used advisedly here since in places it was rather steep and the rocks loose. At the same time we stepped out of a chapter in Oregon's history antedating Ezra Meeker and the coming of the great emigrant trains —from those early times when the nation was just be-

ginning to strain its eyes toward the "Great Luring West". As we went down from the mountain, the atmosphere again took on the warm closeness of the valley and our thoughts became more commonplace. That night we slept beneath the stately Lombardy poplars that always enclose eastern Oregon ranch houses in a grateful hollow square of shade.

The new day was ushered in by a great yelping outside the tent. The ranch dogs had surprised a coyote slinking close in hope of getting a turkey or lamb.

As the sun broke over the Malheur ribs of rim rock, we got our rubber-shod iron horse—our trusty car, that never failed us in all our two thousand miles of desert or mountain road—and started off along the edge of Alvord Desert.

Formerly few persons ever ventured into this desert country. As yet few motorists have discovered it, or perhaps they have not explored it because they fear it. One does not cross hundreds of miles of "high desert" where only sage-brush grows and not even jackrabbits exist, without thinking twice, and most travellers decide not to make the attempt. The tourist who dislikes the thought of being deprived for a time of customary creature comforts stay near the electric-lighted auto camps. They do not like the barren, silent places of the world, and consequently they miss some of God's finest pictures; they never know His greatest creations or some of the deepest emotions: the hush of the desert, the music of the rain on a tropical sea, or the symphony of the jungle.

A region of great distances! Right here I recall one thing the old sage of Pueblo said, just to indicate to you that it all depends upon one's point of view, "You come from the Valley, eh?" (Meaning the Willamette) "Well, they're funny people in the Valley—not enough distance;

can't see out." I mentioned this merely to show you that if we found some of these people strange and different, they regarded us in the same way—it all goes to show the necessity for getting acquainted in order to dispel misunderstanding and suspicions. Easy communication and education are the best means of removing such misconceptions.

Our automobile purred contentedly over the desert road which was fairly smooth, because of disuse, and soon we came out onto Alvord playa, a real honest-to-goodness waste land. We examined the sand and found we could drive on it. Shifting sand, frequently found in old lake beds, is not an ideal road material, but this old lake bed would have proved a wonderful place for auto races—twenty miles of level, hard, white surface of exceedingly compact fine-grained material, partly clay, partly sand, as smooth and firm as a dance floor.

Our motor gave one joyous leap and away we sped defiant of all speed cops. As we tore across the creamy white expanse we saw far ahead that most interesting, and at the same time most awesome, sight of the desert, the mirage. Now and again we passed a bleaching skeleton of some animal which had headed toward the apparition of water. What if something happened to our car out here! Well, we shut out the thought and sped on.

We must not fail to mention here a side excursion to the Borax lakes at the edge of the Alvord Desert. As many thousands of tons of borax were teamed out of here some scores of years ago, we felt that this would be something of economic interest. We took a winding, sandy road which serpentined its way through the sand dunes past some little cold water lakes toward a low knoll in the distance, on which we could make out some dwellings of some kind.

As we drew nearer, we found that the slight elevation in this part of the great playa was due entirely to the deposits of sinter left by the evaporation of hot springs. On the crest of this roughly circular mound was the great pool of the hot lake, and around the fringe of this inverted saucer-like area were some dwellings. These were low, built of stone (a soft volcanic tuff) thatched with sod and tules. As we were surveying the rims of the old soda and borax evaporating works on one side of the place, there approached us from the houses two men, Danes. The younger of the two particularly attracted our attention since he was the largest specimen of a human I remember ever to have seen—perfectly enormous, bearded, but very mildly spoken, and with a kind, blue eye.

These men were simple ranchers engaged in the raising of hay and cattle. As I looked at them I was attracted by their eyes—clear, bluish-to-gray eyes; eyes that were far-seeing; eyes one could trust, for they were steady—they did not shift and blink.

My mind was wandering a bit when one of the boys called me down to the old works to see some fine salt crystals he had found. We spent a long time prowling about this place, examining the hot lake and studying the terraces it had built up. Later we went down among the dunes where there were some small cold-water lakes and had a good plunge. This little oasis was, all in all, much like an island in the sea—a little unit of civilization isolated and surrounded by a sea of sand and silence.

Toward evening we came to the mouth of Wildhorse Canyon and found a homesteader who let us camp in his field near a well. The homesteader was from Missouri and called us "strangers" in the friendliest manner. That night we spread out our blankets by the straw stack and

made plans for the ascent of Wildhorse to the summit of old Steen's Mountain.

I have said that we camped by a well. A well in the desert! Since the time when Moses smote the rock and therefrom the water gushed forth and slaked the thirst of the wandering children of Israel, water has been sought by means of all sorts of devices—witch sticks, divining rods, and various hocus-pocus machines—but in these latter years, the methods of the geologist, which include the study of the structures of the rocks, the precipitation of the region, the nature of the rocks, mineral composition, and other details too technical to be elaborated here, have come into vogue and by them artesian basins have been located and many thousands of square miles of arid land reclaimed. But though the water has been wrested from the storehouse in the depths, much remains to be done to unlock the grip of some of the larger companies on the surface waters. Today the settler is at death grips with some of the "Big Interests" over water rights. This does not mean that all of the large companies have "hogged" the water; in most cases the larger companies were on the ground first and acquired their rights in a perfectly legitimate way. Today conditions are changing and the water supply is not keeping up with the new demands. Water is the sine qua non (without which nothing) of eastern Oregon.

"If I get my water rights, I'll stick; if I don't, I'll hit the trail back to old Missouri," said the rancher. "Can't live without water, stranger, not in this land of sagebrush and jackrabbits."

The next morning while my companions were packing up, I looked up from my work on the car, which we were going to leave behind for two or three days, out across the Alvord Desert and saw coming down a dry gulch onto

a flat, a white object, moving very slowly. We watched it a long time and finally with the aid of field glasses made out—could it be true—the covered wagon. It was not a tented Lizzie, but a real old prairie schooner and two stout mules. Back to the days of '47 and '53! And as we gazed at the tented schooner our imaginations supplied the rest and there filed down into the valley a long train led by the pioneers: a line of wagons; dusty and weary women tramping along with the men; others on horseback, and all with their eyes straining across the alkali toward the great escarpment of Steen's Mountain. They must have wondered how they would cross this obstacle and how long it would take to reach the fertile, and perhaps only legendary, valley of the Willamette, beyond.

The next day our little cavalcade of four—three men on foot and a pack-horse sweated and toiled up the beautiful canyon of the Wildhorse. The narrow and lava-rimmed canyon was redeemed by the glorious careening Wildhorse, a shining and scintillating streak of silver, pure, joyous, and wild. How like the Oxus dashing from its high mountain cradle in the *Pamere!* We traced it to the little lake high upon a bench in a beautiful *cirque* of nine thousand five hundred feet, and there we left it to the wild creatures. We went to the other side to the Kieger Canyon.

A hunter and guide of local fame joined us and steered us up to the head of Kieger Canyon by way of eight miles of as fine a piece of glaciated country as we had ever seen. The glaciated part of this canyon is marked contrast to that of the lower part. The lower portion, which the ice never reached, had the typical V-shaped cross-section, in great contrast to the U-shaped cross-section with the canyon walls veneered with glacial debris.

After a night of intense cold, for August (we slept at nearly ten thousand feet) two of us went to the top and two remained below in camp. As we waved a salute from a narrow ledge several hundred feet above our companions, we heard a voice come back clear and full from the camp below, "Look out for the lava bear!"

We saw no lava bears, but we did see a lone man, a hound and many sheep on top of Steen's Mountain. The man was a Basco (Basque) herder; the sheep, some four or five thousand strong, had the distinction of being the highest band in Oregon, grazing at an elevation of ten thousand feet.

Inquiry everywhere revealed the fact that these Basques, formerly from either the French or Spanish side of the Pyrenees, were splendid, hard working, thrifty citizens, and the best sheepmen in the country.

On our way up we passed several stone huts inhabited by these Basque sheep-herders during the late fall months. They are just the same simple structures one can see anywhere in the mountain districts of Europe today. And among the most interesting pictures of all in this semi-primitive life, was what we saw on the trunks of the quaking aspen trees which grow in great groves through these canyons and on the lower slopes of the mountain. Some shepherds, trying to kill time, had carved all manner of images on the smooth, white bark; animals, such as deer heads, human figures, generally in the nude, fighting bulls, etc. Some were crude, others showed real, even though untrained talent. In these Homeric and Cro-Magnon surroundings we whiled away many happy hours, storing up reel on reel of primitive beauty to be unwound at leisure when we came again to the monotonous valley settlements.

Steen's Mountain is not unlike many other mountains in

southeastern Oregon though it is "built" on a grander scale than any of the rest. A great block comprising several hundred square miles, tilted toward the west. On the west side there is a long gentle slope of only a few degrees, five or ten percent, perhaps. The east side, however, is a very steep and rugged escarpment of four thousand feet. If one stands on the top of the mountain and looks off to the west, and is not too close to the deep gorge of the Kieger, Wildhorse, and Blitzen, he sees only a long gently sloping plain. If he walks to the eastern edge and looks down he finds there a tremendous jump-off of thousands of feet to the Alvord Desert. On that side he looks down precipitous cliffs and rugged slopes deeply incised by high gradient streams. On the one side a man could ride a horse at full gallop; down the other only mountain goats could make their way with safety.

And here we sat us down on the summit of the mountain, and for a moment forgot the technicalities of geology. To one of the party, at least, those stupendous lines from the Book of Job came to mind with a meaning never before appreciated:

"Where wast thou when I laid the foundations of the earth?
"Declare if thou hast understanding who determined the measures thereof, if thou knowest?
"Or who laid the corner stone thereof when the morning stars sang together,
"And all the sons of God shouted for joy."

Chapter XVII

THE BURIED CITY OF THORN LAKE

"NOW, doctor, you're a geologist and I know you'll be interested in seeing our buried city out in central Oregon. Can't you plan to come over some time and we'll explore this together?"

Thus was the invitation extended to me along about 1916, by the late Colonel "Bill" Hanley, the "cattle king" of eastern Oregon. It wasn't until several years later that I had an opportunity to go out into that region and solve the mystery of the "Buried City".

I stopped at Bend, and got my friend and former student, Phil Brogan, to go with us. Phil is an unusual newspaper man and a very fine one. Because of his several courses in geology including field work, he has a technical knowledge of the subject far beyond that of any journalist I have ever known. He is invaluable today in interpreting Oregon geology to the layman because he, through his newspaper training, knows what is interesting and how to say it.

We took the highway west to Burns and thence a short distance down to Silver Lake postoffice. At that time Silver Lake boasted the reputation of being the farthest postoffice from a railroad of any in the United States. The small town lies out in a beautiful valley much of which formerly was a great lake. In fact in 1882, according to the United States geologist, I. C. Russell, there was six feet of water where now is a great pasture.

Another thing I shall always remember about Silver Lake is the great holocaust that occurred there several years ago one Christmas Eve. Several hundred people were crowded in a none too large frame building celebrating, when the trimmings of the tree caught fire and there was a stampede for the door. The door opened inwardly and soon there was a jam. If my memory serves me correctly the deaths totaled over a hundred.

As Thorn Lake, our destination, is adjoining Silver Lake and formerly was connected by water with that body, we did not have much farther to go. Turning off the main highway, we rolled down through sage-brush into a dry, nearly circular depression about one-fourth of a mile wide, and made camp on the old playa (dry lake bed). Strange to say, a rain came up in the night and fearing a torrential downpour, as sometimes happens in eastern Oregon, I moved my bed out of the smooth depression onto the higher sage-brush land and waited till morning. Fortunately next day was bright and clear and even before breakfast I rushed down into the old lake bottom to examine the "walls" of the "Buried City".

As I hammered away at the rocks I saw the Colonel watching me closely but I didn't give any inkling of my findings until after breakfast. By that time I had made a preliminary survey of the "ruins" and had come to a tentative conclusion, which by the way I have never swerved from to this day, the hotcakes and coffee were ready.

"Well, Doc, what do you make out of it, is it Inca or Pre-Inca?" asked Phil.

"I can't say yet, boys; a geologist shouldn't jump to conclusions so quickly. I am wondering, of course, just why the founders of this city, if it was one, ever picked a lake bed as a place to locate it."

"Maybe," said Colonel Bill, "they located here long before any lake was formed."

"Quite possible, but"—I began, but was interrupted by one of the students I had brought with me.

"Why should the walls of this city run so crazy—see they go in every direction, and they have no uniform thickness."

And so we argued back and forth and finally when pressed for my conclusions by Colonel Hanley, I told him as diplomatically as I could that these supposed "walls" were *clastic dikes*, mainly sand and volcanic ash that had sifted down into some giant cracks in the bottom of the old lake bed and had become hardened. Because of different material with somewhat better cementing material binding the sand grains together, the dikes had resisted wind erosion better than the soft lake bed deposit and so they stood out like little ridges (dikes) or "walls". As most of the dikes radiated out from a near central point and were quite irregular in direction, width, and spacing, they naturally did not fit into any reasonable pattern of a rational house or "city".

One of the natives of the vicinity excavated about fifteen feet in length of one of these dikes which had a rude snakelike shape, with flattened head and tapering, even slightly curved tail. Really the likeness to a python, or boa constrictor, was almost startling and at first I was almost convinced myself that we had a "fossil serpent". Again, I, being a scientist, had to shatter another illusion and spoil the show—yes, maybe and maybe not—I suspect if you go to a certain service station in Silver Lake today and inquire about the "serpent", they will show it to you and be d—d to the smart-aleck geologist, who would not know a snake if he saw it.

So you see they have sea serpents off our coasts and

fossil serpents out in the deserts. Well, if they are happier believing in such things why should we scientists be going around trying to spoil things? Therefore, Mr. Tourist, take the high road over the high desert into central Oregon and pay a visit to Thorn Lake and its "buried city" and see for yourself.

However, if you are not interested in "buried cities" and "fossil serpents" you might drive north twenty-five or thirty miles out near Lake postoffice, which boasts of just two buildings, to Fossil Lake and scratch in another old lake bottom for fossil flamingo bones. Think of it, flamingos at one time in Oregon! And this is no "pipe dream". This time (the Pleistocene) Dr. Condon, the pioneer geologist of the Oregon Country described many years ago in his book *Oregon Geology*. However, this is another story for another time.

There is still another scenic feature of this central Oregon country which I had almost overlooked, namely Fort Rock, about 60 miles southeast of Bend. This unusual topographic feature stands out completely isolated from any other hills or mountains on a generally level surface. At a distance it looks not unlike a round fortress of some kind. When one gets closer to it its true nature is revealed. It is really an old eroded volcanic cone of more or less fragmental material (agglomerate) whose top and south side have collapsed and have been removed by erosion. Its outside walls are approximately vertical. The highest point of the rim is some three hundred feet above the valley floor. Closer study reveals that once a large lake completely surrounded it, the waves of this lake undercutting the formerly sloping outer walls of the old crater. This was in late Pleistocene or early Recent time.

Nearby in another prominence of volcanic rock is a small grotto, the Menkenmeier (named for the ranch on

FREMONT HIGHWAY

Lakeview Chamber of Commerce

ABERT RIM *Eastman Photo—courtesy Lakeview Cham. Com.*

OREGON'S BIG TREES

which it is located) cave in which interesting human artifacts were found by Dr. L. S. Cressman, University of Oregon anthropologist, buried beneath pumice which came presumably from Mt. Mazama. From this and other data we can assume that man was present in this part of Oregon perhaps at least 5,000 years ago.

Chapter XVIII

THROUGH THE PICTURE GORGE TO THE ANCIENT LAIR OF THE OREODONTS

GOING through strange doors and gateways into new, or old worlds not visited before is one of the finest pastimes I know of. I remember what a "big kick" I got when, for the first time, I poked my head through the Chen Men Gate and entered the buzzing human beehive of the old city of Peking. What a strange world! Another time I entered the portal of the Marble Halls of Oregon and then I entered an entirely different realm from any I had visited on top of the ground.

Now when one goes back into past geological history he gets into something still different. That is the most interesting thing about the study of geology—it permits you to enter interesting Time Worlds, really "Lost Worlds" to most people, which long antedated anything we have on earth today—not one but many worlds, all with different lands and seas, different climates, different plants and animals.

There are many of these geological portals which one can enter in Oregon but if he doesn't know something of geology, he will pass through the portal and see comparatively little—oh, yes, he will often see beautiful scenery but with some knowledge of this subject he will see all the scenery plus a lot of other things.

If you are zooming along the John Day Highway, after going through the little town of Dayville, you will pass

through one of the most interesting of these geological portals. About four miles below this little town, the highway turns suddenly to the north and passes through the Picture Gorge, an exceedingly narrow defile, cut through twenty-three flows of basalt of the Miocene age. These are a part of the great Columbia River Lava Series, the same as that exposed along the Columbia Highway. Owing to the inclination of these flows to the southward, as you go through the gorge from the south to north, you cut through the entire series from the top down. This gorge gets its name from the picture writing left by some Indians on the rocks near the south end of the gorge. There are many of these pictographs and petroglyphs scattered over the state. The former are figures painted in ochre on the rocks, while the latter are rock engravings. But this is another story which perhaps you have already heard about from others. Although these inscriptions are probably quite old, as far as the human history of Oregon is concerned, they long post-date the things we propose to introduce you to in this chapter.

When you come to the north of the gorge you enter a sort of basin where the stream has cut a much wider valley, for the formations that lie below the basalt and down to which the stream has cut its way, are much softer. This is known as the Big Basin of the John Day and on your right (east) is a pyramid-shaped hill or small mountain called Sheep Mountain. It is capped by a small remnant of Columbia basalt. The lower part of the hill is made up of variegated layers of volcanic tuff (coarse fragmental material) blown out in prehistoric devastating explosions. The occasional torrential rains of that part of the state have gullied these formations so that they resemble the Dakota Bad Lands. There is a fair approach to stratification in some of the material and some

differences in color as one examines the individual beds, but generally there is a blending of color without too sharp a definition. Some of the colors are buff, mauve, green, and red ochre, and on a small scale simulate the colors of the Grand Canyon.

Most tourists give these rough canyon walls but a fleeting glance out of the corner of the eye in their haste to get to The Dalles for lunch or Portland for dinner. However, let us stop and poke around a bit. Here is where we may pass through the portal into one of the most interesting epochs in Oregon's long geological past.

If we get out of our cars for a bit and snoop around at the base of those buff-colored slopes we might have the good fortune to pick up a rhinoceros tooth or the ankle bone of a camel.

"What!" I hear you exclaim, "camels in Oregon? You don't mean to say some of those 'Washoe ships of the desert' used to pack in salt for the mining operations at Virginia City, Nevada, got way over here in Oregon!"

"No, sir, I'm not thinking of any stray camels from Nevada, but of beasts that lived many millions of years before there was any Nevada or Oregon as we now know them."

Let me tell you briefly the story of how these interesting fossils were first made known to the world. The full story you may read in Condon's "Two Islands" or the revised edition entitled "Oregon Geology". Very briefly, the story runs about like this: Condon, then a very young man, was a Congregational missionary at The Dalles. In addition to his pastoral duties, he was a collector and amateur student of all sorts of natural history objects, and had begun to get together a "cabinet" of specimens which attracted the attention and intelligent interest of the entire countryside. As the hinterland of The Dalles

in those early days (1863-) was still pretty much in the possession of its Indians no one except soldiers and trappers went very far into the wilds of central Oregon. One day some United States troopers, who had been on an expedition into the John Day country, brought in some fossil skulls and other bones to the young missionary. Condon saw at once that a discovery of great importance had been made and on a subsequent expedition he accompanied the soldiers and opened up one of the world's classic fossil localities. Since Condon's time careful researches by others, notably the eminent paleontologist of California, Dr. John C. Merriam, has made the story more complete so that we know more about the conditions of central Oregon in the Oligocene Period, several millions of years ago, than we do about some parts of Curry County today. Here is a quotation from Condon himself:

" . . . . . Through the heart of this wild region winds the John Day River, running westward until it passes the middle ground of the picture and then turning northward to join the Columbia. This stream, so insignificant in appearance, has done wonderful work among these hills. The river itself was, in the olden times, merely a series of connecting links between a chain of lakes that extended from the Blue Mountains to the Cascades of the Columbia. It has for unnumbered ages gone on excavating vast gorges and canyons as all other streams in central Oregon have done, 'till lake after lake was drained off, and their beds laid dry, stripped of enduring moisture, and slowly changed to a treeless desert. The deep excavations that resulted could hardly fail to lay bare important records of the past, cutting as they do through the whole extent of the Tertiary deposits. In a deep canyon through which runs a branch of Current Creek, may be found the remains of the fan palm, with abundant remains of a

beautiful fern, gems of their kind which no thoughtful mind can see without wonder and admiration. In another ravine are seen in great numbers the remains of a yew, or yew-like tree, that sheds annually, not its leaflets, but its branchlets; for in this form they are found of almost uniform length and structure imbedded in the rocks. This tree was evidently abundant upon these ancient shores, for it can be found at almost every spot where a little stream washed its miniature delta into the lake. Oaks, too, and occasionally a fine impression of an acorn, or acorn cup, are found at intervals from this place to the Blue Mountains.

"But the great geological importance of that old lake depression does not arise from the fossil remains of its forests—beautiful, varied, and abundant as these are—but from its finely preserved fossil bones. Two species of rhinoceros lived their quiet indolent lives among the reeds that lined that old lake shore. A little beyond the southern spur of that distant mountain there evidently emptied a stream of some size, for its delta is strewn with fragments of silicified bones. Among these, bones of the rhinoceros are frequent, but the remains of an extinct animal, allied in some characteristics to the camel, in others to the tapir family, are most abundant.

"Paleontologists have designated the genus by the name of Oreodon. The remains of three or four species of this animal are found in central Oregon. One of these, new to science, was discovered thirty miles from here, and was named by Dr. Leidy, Oreodon Superbus, from its superior size. The shaly rocks in which these remains are found are very brittle; and the enclosed fossils partake of that brittleness to such an extent that, if not handled with the utmost care, they crumble into small fragments. Two nearly entire heads were discovered in a ravine that

opens into Bridge Creek Valley. They had been exposed all winter to rain and frost and were very brittle—almost ready to drop to pieces. They were passed by until the following day, when a careful treatment to several coats of good flour paste was rendered the more efficient by additional pasting on of common paper. This was kept on for awhile, when it was carefully washed off and a more permanent preparation applied. These specimens now make a very passable appearance. Mute historians are they of the far distant past, uniting with hundreds of others to tell strange stories of the wonderful wealth of forest, field, and lake shore of that period. . . . . "

Now you will naturally ask, "Why was it that when the Spaniards came to the New World they found no horses, oreodonts, camels, rhinoceroses, or elephants?"

Well, that is a long story and many things may have happened to them—change in climate, enemies, devastations from volcanoes, disease, floods, etc. We are still piecing together the fragments of the story. However, in the case of the John Day animals, we can feel sure that vulcanism had a great deal to do with their disappearance for these animal remains, only hard parts like especially hard bones and teeth, are completely encased in volcanic fragmental ejecta of ash and the coarser tuffs.

So when next you spin along the beautiful John Day Highway at sixty-plus, just rein in for a bit as you emerge at the north end of the Picture Gorge and give a little thought to these pageants out of Oregon's storied past and think upon the life and work of that kindly "Man of God" who became the Pioneer Geologist of the Oregon Country, for in time, we predict, no name will stand higher in Oregon's Hall of Fame than his.

Chapter XIX.

THE HOLE-IN-THE-GROUND AND WHAT BECAME OF IT

THIS is the story of one of man's great battles with Nature, and how he transformed a desert into land of rich farms and happy homes.

Over on the eastern boundary of the state is a county to which has been given the name Malheur, which is the French for misfortune, unhappiness, woe, and any number of similar synonyms. Many of the people living there do not know the significance of the name. For much of the country, the name seems quite appropriate, while for other parts of it, this appelation does not fit at all.

When I first saw the "Hole-in-the-Ground", however, I said, not "Malheur", but "Mucho malo" (bamboo Spanish for something worse). Barren, "busted rim-rock", sagebrush, rattlesnakes, and alkali! But look at it today, and see what the modern engineer with his magic wand has done. Where once was the "Hole-in-the-Ground" there is now a beautiful lake some fifty miles long and the yawning box canyon has been sealed up by one of the world's highest dams.

Through great tunnels on either side piercing the hard brittle rock, life-giving water is pouring out onto the arid plain below the dam and human habitations are springing up in the erstwhile desert. To reach the Owyhee Damsite one turns off the main highway at Nyssa and follows a new road to the southwest. This broken lava plateau coun-

try is dotted with a number of prominent buttes, notably Mitchell and Black Jack Buttes. Outside the lower irrigated flats the typical vegetation is sage-brush, junipers, with willows and cottonwoods along the creek beds. The landscape and vegetation is typical of steppe country.

The name Owyhee is interesting as it appears to be corruption of either Hawaii or Oahu, or perhaps both, dating from the time when there was closer connection between Oregon and those islands.

In 1927, after I had finished a month's field work with my geology students over in the Wallowa Mountains, I was asked to make a report on the "Hole-in-the-Ground" damsite, and spent 21 days on this investigation. I shall never forget my first trip by boat through the Box Canyon between the precipitous walls of rhyolite where the great dam is now built. The sides of the canyon were fissured to a remarkable degree, and for a time it looked as if the site would not prove to be suitable for this structure. However, on examination, it appeared that the great seams in the rock were pretty well sealed by clay gouge that would be practically impervious if no further movements, due to earthquakes, took place in this region. When they came to build the dam, considerable stripping of loose rock and grouting with cement was found to be necessary in order to seal the structure firmly in place to its abutments. It was also found that a great fracture existed in the bottom along the trend of the box canyon. The dam is 405 feet in height and its cost of construction was $6,000,000. The capacity of the reservoir is 232,983,000,000 gallons.

The chief construction engineer was Mr. F. A. Banks of the Bureau of Reclamation and he did a very fine job. Today Banks is building another dam, Grand Coulee, the largest structure ever built by the hand of man.

Today thousands of settlers, driven out of the "Dust

Bowl" are getting another chance in the new-old land of Oregon. One of the first sights to greet them is the blooming, newly reclaimed lands, recently reclaimed from the deserts by the plugging up of the "Hole-in-the-Ground". Very soon the coyote's howl will be replaced by the lowing of well-fed cattle and the laughter of happy children.

As a consequence of the tragic droughts in the Great Plains and adjacent regions of the United States these vast reclamation projects in the west at last seem to be justified and their promoters vindicated. There is no more new land in the west except as we reclaim it from the desert or the forest. We must conserve our forests, so we are driven to carry the fight for more and more land into the arid and semi-arid regions of the fast vanishing old West.

Chapter XX.

"THE SWITZERLAND OF OREGON"

THE poet Sandberg once said:

> "If men tell you no stories about rockets, shooting stars, or horses of high ranges, let them ask your pardon, excuse themselves, and go away."

Those who merely go as far into this country as the motor road will permit will never know what Sandberg had in mind.

Wallowa county, like Gaul, is divided, naturally, into three parts: The high mountains, the valley, and the Snake River plateau. It lies in the extreme northeastern part of the state and the mountainous portion has come to be known as the "Switzerland of Oregon". The writer came to know it and love it from his first visit there with the Mazamas in 1918. Nine years later, he revisited it in charge of the annual Geology Summer Camp of the University of Oregon. Again in '38 and '39 he spent many more weeks there enjoying its charm.

From lofty ice-crowned Eagle Cap to the somber depths of Hell's Canyon, in the Snake River, from the flower-splashed Alpine meadows to the yellow grain fields of beautiful Wallowa valley, from the tiny jewel-like lakes of the Basin to the rippled surfaces of Lake Wallowa at

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*This appelation is used more by outsiders than by the people of Wallowa county.

the foot of the range, one can exhaust his superlatives in describing the scenery and geology of this unique corner of the state. Is it any wonder that the Nez Perces fought so hard against our government when we dispossessed them of their homes in this fair land!

It is appropriate, first, that we pause beside the monument recently so fittingly erected above the grave of old Chief Joseph at the north end of the lake, and as we watch the evening sun withdraw its warmth from the mountain walls, we hark back to distant days before the coming of the white man. The lake is quiet in that far summer time. Perhaps the men have just come in from mending the *lacallahs* and *wallowas* (parts of their fish traps). Already the glow from campfires and voices from the tepees along the lake margin tell of other life than that indicated by the bark of the coyote or the daring leap of the mountain sheep.

Hovering over the piles of granite and lava and marble is an ominous black cloud which may dissolve and disappear or may burst and bring down avalanches of snow and riven rock. Suddenly out from the shadows along the shore darts a frail canoe and with great speed makes for the opposite shore. When the tiny bark gets well out in the middle of the lake, a terrible thing happens. The storm bursts with titanic fury and the waves now grown from ripples to white caps overwhelm the boat and its struggling human burden. As quickly as it came, the storm passes and goes bellowing and growling down the valley. The waves subside and the seething surface becomes quiet and glassed over again. The canoe and its occupants have vanished. Later a dark overturned object is seen driftng helplessly toward the outlet of the lake. Torches flash hither and thither along the bank, excited voices, cries, and wails pierce the gloom. Legend tells us that a young Indian

brave, who had stolen the daughter of the chief, had been the propeller of the ill-fated bark, and that when he was in the act of making off with his bride-to-be, the storm broke and thus the Great Spirit wreaked his vengeance. Since that untoward event, so the legend goes, no Indian has ever dipped paddle into the waters of Lake Wallowa. Today, motor boats, steam launches, and the clumsier fishing boats carry thousands of carefree white maidens and youths back and forth above the grave of these early Americans, and the lake now furnishes cold mountain water to thirsty men and grain in the valley towns and grain fields. Today old Chief Joseph sleeps quietly in the shadow of the giant peaks, while restless tourists or inquisitive geologists invade his once happy hunting grounds. And we, with the coyote pack in some nearby canyon barking its defiance at the shrieking motor horn, and the tinkle from peaceful dairy herds in the valley coming to our ears, go home to camp and prepare for our hike tomorrow, an assault on the Matterhorn, which long ago sent forth its challenge to the Redskin bucks of the tribe.

In the early morning our party divides, each taking its share in the good-natured struggle up opposite sides of the old mountain. Only a few of us reached the top. One party, after a valiant six-hour climb, found itself balked by a sheer cliff just two hundred feet from the goal. Of the other party, only two, after perilous scaling of knife ridges over treacherous shell-rock slopes, dared go on. The rest of us had to admit that that mountain was "no good mountain nohow".

Right here is where I might tell you stories of rocks and shooting stars. Those of you who know the beauties of the sky seen from high elevations at night do not need to be told of these things. You have seen the meteor flash across the sky; you know the thrill that comes when you gaze at

the incandescent star dust, as it falls to earth and you wonder just where. Well, we'll have to leave the story to the astronomers and the poets—we must stick closer to rocks. But if I do not tell you here of rockets, I can at least tell you of interesting minerals which, if you take them into a dark room and scratch them, will flash fire like flint on steel. "Radium?" you ask. No, not radium this time. Several minerals such as fluorite and sphalerite have this property. The latter mineral has been found in these mountains, but specimens of fluorite, though very likely present, have not yet been reported.

On a shoulder of Eagle Cap, the central peak of the range and nearly ten thousand feet high, rests the one and only glacier left in the range. It is a remnant of the great alpine glacier that once ploughed its way (twelve miles) down to the back door of the present little town of Joseph. This large ditch digger of the past, following a pre-existing river valley, threw up along its sides the enormous lateral moraines seven hundred feet high and the less regular terminal moraines, which add so strikingly to the landscape about the lake. Like stupendous railroad embankments constructed seemingly by some prehistoric race of giants, they are indeed remarkable topographic features that often the layman is hard pressed to account for. To have built these embankments of morainal material all of loose boulders and sand, several hundred feet above the level of the water in the lake, the ice-stream must have been close to several hundred feet thick. The lake itself, long reported by the credulous to be bottomless, is two hundred and eighty-three feet deep, and according to the twenty or more soundings our party made, is comparatively shallow. The writer does not hesitate to say that this is the most remarkable lake of its kind he has ever seen, and he has seen some of the best of them, especially those on the

south side of the Alps in Northern Italy. Of all the lakes of Oregon, it is second only to Crater Lake. Of course, in the matter of color, Crater Lake has no rival, but aside from this one feature, Wallowa Lake, to me at least, appears to be the most beautiful in our state so replete with beautiful lakes.

The scenery of the higher Wallowa Mountains is dominated by those features characteristic of glaciated regions with the particular character profiles resulting from them. Some of these are U-shaped valleys, *cirque* amphitheaters, *roches moutonnes* (sheep backs), *aretes* or comb ridges, *cirque* lakes (of which Aneroid Lake is one of the best examples) and *moraines*. All of these features are in great contrast to those one finds characterizing the lower parts of the range or in the canyon areas still farther down.

Still another striking contrast to what one sees in western Oregon is in the topographic forms so often found in eastern Oregon, namely the lava rim rock. In many places these give a concave profile on slopes, while in western Oregon such slopes are invariably convex. Not only the student of physiography, but the landscape artist as well, is amazed at the great topographic variety and contrasts in this region.

It seems a far cry from snow and ice fields to coral seas and palm groves, but you can take the journey right in Wallowa county and not go more than a few miles to do it. "Preposterous!" you say. "Corals grow in warm tropical waters only." Again the (old) adage is proved true, that "Truth is stranger than fiction". This reef grew far back in Triassic times, perhaps ten million or even sixty million years. Now as to the palm trees—I'll have to plead guilty on one count—I haven't really seen these yet nor even any fossil palm leaves from here, but isn't it natural to expect them? It is like serving boiled potatoes

with fish. They always go together—coral seas and palm groves, of course.

There are three places in particular in the world where vulcanism has been rampant in the past. To be exact, in that part of geological history known as the Miocene—one of these regions is East Africa, the second in the Deccan Plateau of India, and the third and largest is that of eastern Oregon, Washington, and parts of Idaho. The Wallowa country was once thought to have been only partially submerged by this devastating flood of molten rock. From our researches, we discovered that even the region now consisting of high granite and marble mountains was covered with lava, for today we find some of the highest peaks of the range capped with lava. Erosion has removed this capping in part, and it is not found everywhere on top of the older peaks.

The best place to see this flood of lava in section is in Hell's Canyon of the Snake River. In this remarkable gorge with one thousand feet of vertical cliffs along the eastern boundary of Wallowa, flow upon flow of Miocene lavas totalling nearly four thousand feet in thickness, can be seen in section resting upon an old Eocene (Dawn of the Recent) erosion surface with mountains and valleys long since buried, now being exhumed by the river from the tomb of time. Below the line of demarcation are older flows of andesite and basalt all dating from the Paleozoic or Mesozoic age. In this enormous V-shaped trench we can literally see down into the bowels of one of Dr. Condon's "Two Islands". When you look into the Snake River Canyon, you might remember that this slash in the earth is deeper and wider, if you start with the Seven Devils and continue up to the Wallowa Mountains on the other side, than the Grand Canyon of the Colorado; in fact, it is the deepest known cut on the globe. Hardly less won-

derful is the canyon of the Imnaha—that is, if you are a fisherman!

If time permitted, we might tell you of the interesting life and occupations, agriculture, lumbering, stock raising, and mining of this region. There are tales of heroism, of the sacrifice and conquest which might be recorded in the saga of these enterprising people in this far corner of our state but we cannot linger over them now. Other pens than ours will gather them together, and some day they will make an absorbing chronicle for our children to read. The potential resources of this area make this a region to be reckoned with in the future. Even now there is a revival of mining development which will soon compel us to focus our attention again on Wallowa County.*

However, the greatest asset, materially and spiritually, of this wonderland, is its scenery. This has reacted upon the people who live here. We find a kindness and gentleness in them that is very satisfying. People cannot long be hardboiled and selfish in the midst of natural beauty. And so, for town-weary tourists, for the cynic and grouch and all the mentally sick we would strongly recommend a sojourn in this one of Oregon's finest playgrounds.

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*The Cornucopia, the largest gold mine in the state, is on the southern flanks of this range.

Chapter XXI.

A CABIN ON THE SNAKE

OVER along the boundary between Oregon and Idaho runs the Snake on the western side of the Seven Devils Range. Where the Oregon Trail Highway crosses the river near Huntington the stream is flowing in a wide plain but a short distance to the north it begins to travel through a canyon which becomes deeper and gloomier as one follows it to the north. A single track railroad follows along the river bank some eighty miles to a place called Homestead and there it gives up the struggle.

One summer about 1924 I took my trusty Buick and two students and after driving across the entire length of the state we reached this great stream the principal tributary of the Columbia. For a part of the way we went over the mountains to the west and got down into the canyon by way of Robinette and then followed the river on to Homestead passing through a couple of old copper mining camps.

Homestead at that time was a "two by twice" rather decrepit mining village that had seen better days with the typical slab-sided wooden buildings without paint which so disfigured this western country in its boom days.

However before preceeding down the river we climbed one day up out of the canyon at a place called Gypsum, nearly 1500 feet above the stream, and visited a gypsum mine. Here we found a bed of this valuable white deposit somewhat contorted and sheared by the mountain building

forces that long ago had convulsed the region, from which men were mining and sending tons of material by aerial tram down to the railroad below. This deposit bore mute witness to long ago dessication of the country.

At another point some miles below this locality, we came to a veritable oasis in this land of riven rock and sprawling talus. On an old alluvial fan we found one of the finest peach orchards and most beautiful homes anywhere in the whole state. The warm shelter and fine soil here provided just the right conditions for frugal scientific husbandry to develop a perfect garden spot. The grade of peaches was so high that the owner, Mr. Baker, shipped them all the way to the Atlantic seaboard markets. We would have liked to linger longer here, but we had work to do down river.

About 50 miles below Huntington, one comes to Ox-Bow bend, and a short distance on, to Copperfield, another ghost town. In 1913 a most stirring drama was enacted here with a woman, Fern Hobbs, of small body, but plenty of backbone and intestinal fortitude, the chief actor. The story is an old one to most Oregonians, but should never be allowed to fade from memory. To make a long story short, Copperfield had been raising hell, so much hell that Governor West decided to put a stop to it. For some reason he sent his nervy little secretary to do the trick and she did it. So effectually did she and Col. B. K. Lawson, her military aide, do the job, that there hasn't been a "Peep" out of Copperfield in the twenty-three years since that momentous occasion.

After leaving Homestead, our trail led through some old gnarled orchard trees—quite a contrast to the beautiful Baker orchards, and then it seemed to leave civilization completely behind. But just before we thought we had left all trace of cultivation behind, we came to the Forest

Ranger's small neatly kept house. From here the trail became more difficult and soon we began to climb up onto one bench after another until at about three thousand feet above the river we found our destination, Carnahan's cabin, perched high on a shelf half way between the bottom of the canyon and the rim above. Right glad were we to rest after that arduous climb.

For some reason, I have always liked miners' cabins as temporary homes in my travels. As a rule these men usually live in picturesque country and this one in particular was perched in one of the most beautiful spots it has ever been my fortune to visit. The canyon walls were made up of dark Snake River lavas, basalt, flow resting upon flow in a great staircase of the giants. One side of the cabin was on the brink of a precipice, the other side faced a gentle slope back to higher ground out to the west. Down this slope a well-worn trail led to the doorway.

Overhead was a canopy of noble yellow pine trees with their beautiful reddish boles, which in the morning sun were gorgeously lit up by an ethereal glow.

I have been in some quiet places in my travels, the central Pacific, on some Cascade snow field, and in the crater of Wizard Island within Crater Lake, but this spot high up above the bottom of Hell's Canyon is about the quietest place I have ever been in.

After a good supper of mulligan, coffee, and camp biscuits, we turned in and thought we would enjoy a good rest. Well, we did for two or three hours, until we were startled out of our slumber by the noise of pack rats getting into the grub. For a while we entertained ourselves by taking pot shots with our revolvers at these unwelcome night callers.

The view across the canyon next morning was really worth coming hundreds of miles to see. Although the sun

was beginning to peek from behind the great granite range of the Seven Devils and the upper part of the canyon was beginning to light up, far below us the river was still lost in gloom. As the canyon walls began to come out of the shadow, we could see great twisted limestone outcrops and below dark ribs of volcanic rocks representing activity long antedating the outpouring of the Snake River lavas.

For a couple of days we examined some prospects in the vicinity of our cabin and then one day we went down stream to the bottom of the great chasm again to study the oldest rocks in this great gash in the crust of the earth.

After fighting our way over absolutely trailless country, falling over old windfalls and dodging great boulders of tremendous size (also a few rattlesnakes) we came about noon to a small flat near the river. We had remarked on the extremely low humidity as we walked along and we had had word of forest fires to the east of us in Idaho. While the two boys were "washing up" in the river, I started a fire in order to heat a can of soup, but I had not cleared away the dry grass sufficiently from the fire and soon it jumped away through the tinder, and before we knew it we had a small forest fire going. There really was no danger of its spreading, since on one side it was limited by the rock talus slope and on the other by the river. Still it gave us a little concern and we fought it like demons for an hour or more. After about an acre of brush had burned over it was all out save one old snag, and then we sat down to watch this till it was completely extinguished. As we sat there resting a couple of young men who had been haying on a bench on the other side rowed across and offered us some water from their canteen. We had a very congenial chat with them, learning about the mining ventures along the river, and heard some tall stories about

how they went fishing for sturgeon and how they pulled them out with horses.

"Well, you fellows have a good hard hike ahead of you if you want to reach camp before dark," one of them said, "We'll watch this old snag for you, it'll be out soon. You needn't stay down here if you want to be making tracks." We thought it was pretty decent on the part of our new friends and so we "pulled our freight" up the hill to home and supper. We thought nothing more of this episode, but ten days later we were to hear more to our regret.

It has been alleged that this canyon is wider and deeper than the Grand Canyon, but that is not quite true. By taking the measurements from the crest of the Seven Devils Range to the eastward and across the canyon to the top of the Wallowas this would be true. From the rim of Hell's Canyon to the river it is about six thousand feet deep. The lower part is made up of old lavas which may date from the early Paleozoic while the upper portion consists of the Snake River lavas of Tertiary age. Between the two there is a distinct undulating line of demarcation indicating an old erosion surface with hills and valleys carved out of the older formations. Afterward, millions of years later, came flow on flow of liquid basalt which filled up the old valleys and completely covered the old topography. From a vantage point on the Idaho side one can see in this section on the Oregon side the story of what happened.

I had been looking longingly at the giant granite peaks of the Seven Devils for several days and finally could resist no longer the urge to go across the river to see for myself what that country looked like, so we hiked back to the last ford where we got our car across and began the long climb up Klein's Grade, one of the, at that time, most thrilling pieces of mountain road anywhere in the North-

west. Several times I got out and walked and left the job of driving to Mac, who would tackle anything, from steep mountain grades to a pack of wildcats. After a long time, due to many pauses for old Buick to cool off, we reached a point well toward the top and found another ghost town. Cuprum got its name from the fact that copper was the principal metal mined there in earlier days. After sampling an old dump of peacock ore we hiked down Sheep Creek to the famous Red Ledge Mine. The name Red Ledge was given to it because of the remarkable oxidized "Iron Hat" which stood out above the main ore body below. Later on, but on another trip to this country, I made a professional geological examination of this big ore body and found it to be one of the most promising and the largest body of copper ore I had yet seen in the Pacific Northwest. However, with the world copper market as it is, it may be years before this is brought to the stage of production. When it is opened up it will doubtless be by means of a mile long tunnel in from Hell's Canyon on the Snake.*

We returned, after this interesting little interlude, to Hell's Canyon to examine the rocks more closely. This is indeed an awesome canyon and few have traversed it except by climbing over the ledges far above the bottom. Only two or three parties of human beings to my knowledge have negotiated its dangerous waters by boat. One of these is Amos Berg, Oregon's own intrepid young canoeist and explorer, who went through it some years ago by canoe, single-handed, when he traveled almost the full distance of the Snake and the Columbia from far back in Idaho down to the sea; and, later, a party of U. S. Topographers under the command of Colonel Birdseye.

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*This tunnel has since been dug.

Within the past few months still another expedition has successfully traversed it.

While down in this place we ran onto one old prospector who told us of the interesting method of fishing for sturgeon from horseback. "Yer see, friend, it's like this," the old sourdough remarked as he speared another flapjack, "These goldurned ranchers here on both sides of the Snake, they just take a good stout line, almost as big as a rope with a helluva big hook and put a hunk of meat on it and let 'er trail slow-like and when they get a bite they haul in on her and start up the bank with the line tied to the horn o' the saddle and if the horse is strong enough they yank the brute outer the water—and say, I'm tellin' yer they is monsters. Them fish must be some kind of fish what didn't git inter the Ark—they don't look like no respectable fish we get in th' other waters of the state."

Well, pretty soon our allotted time and funds were exhausted and we packed out to where we had left old Buick and said farewell to our cabin on the Snake and voted this one of the most interesting excursions we had yet taken in this state of such diversified scenic attractions.

Chapter XXII.

WILLAMETTE VALLEY SCENE

I—The Upper Valley

THE city of Eugene, founded in 1847 by one Eugene Skinner, lies at the head of the Willamette Valley proper in about the same relation to the valley as a whole as the palm of the hand to the fingers and arm. The McKenzie, the Mohawk, Middle and Coast Forks would be the fingers, the arm the lower part of the valley. Near the center of this palm is a considerable wart, Skinners Butte, and five miles due south is a considerably higher bump of land which has been named Spencer's Butte. From Eugene north, the valley floor for many miles is quite flat, but immediately to the south, east, and west of Eugene are the foothills of the Cascades and Coast Range.

Let us, on a clear, bright morning, take saddle horses and ride south on one of the many lovely bridle trails toward "Old Spencer" that we may get a better picture of this famous valley. We ride around to the south side of the Butte where there is a small fairly level area and a small spring. We tether our horses and take a tolerably steep trail up over the rocky southern slope and after a short stiff climb come out on top of a narrow, north-south ridge at an elevation of 2150 feet above sea level and 1700 feet above the floor of the valley at Eugene. This ridge is made up of quite different rock from that of the surrounding country which is underlain by softer sandstone and shale.

This much greater hardness of the rock in the butte is the reason for there being a butte. Off to the east, west, and south are fold on fold of verdant hills broken here and there by small patches of smoke from early fall clearing fires. The green folds to the eastward rise gradually up to the Cascade crestline, indicated by isolated snow-crested peaks. Looking off to the westward, we see a long bank of haze, the high fog rolling in from the Pacific.

In the near foreground is the city of Eugene, not a large city, not an overly busy city, no great factory chimneys belching dirty smoke, no raucous noises—a quiet, kindly city.

Around about in the countryside are small farms, some old donation claims (640 acres), ranches from the Pioneer days, long lines of prune trees in neat rows, winding country lanes, a clear, silvery stream running through the picture from east to west—on the whole just an ordinary country scene, nothing grand, but infinitely peaceful and satisfying. As we gaze upon this beautiful valley, the home of Anglo-Saxons and Scandinavians, we cannot help but recall that this valley is one of the few places in the world where true democracy still holds out against the newer cults of the day, Communism and Fascism. And what is grander in all human experience, more interesting and important than belching volcanoes or roaring cataracts, than the peaceful rural homesteads of hardworking, honest husbandmen? After all, the most interesting thing in the world is man and when we have man at work, creating and not destroying, we have one of the finest pictures on earth to contemplate.

II—The Middle Valley

Let us go down the valley to the neighborhood of our

capital city and take a run up into the Waldo Hills just east of the town. Today we can run out on ribbons of concrete and bitulithic pavement to the red hills that overlook the valley of the middle Willamette and cover as much scenery in an afternoon in a car, as the first immigrants could traverse in a month with ox team! But would we see any more—well, that is a question. Some modern travellers would certainly not.

The best time to see the Waldo Hills country is in the spring, when the fruit and nut trees are in blossom. Go east from Salem past the penitentiary and there just before you come to the tuberculosis hospital, turn up the hill and keep on going till you get to the top. If you like trees and rich red soil (red-shot, they call it) and gentle curves, following Hogarth's line of beauty, then will you find just the landscape you have been looking for.

Every particular climate and distinctive geological terrain has its own peculiar land forms—for instance, in the desert there is the typical arid profile, which is concave, while humid regions have convex profiles and gentle curves. In both the tropics and the far north land forms tend to be subdued, though often in the tropics where there are volcanoes, the topography is quite rugged and by no means subdued.

We become accustomed to these character profiles of our homeland, and when removed from their familiar contours, become homesick. This is so with most people.

The country of our middle Willamette Valley and surrounding hills is very typical of this particular part of the world and its particular formations—i.e. basalt hills, flanked by soft sandstones and shales, in a region of copious rainfall. Those of us who have spent a few years here become very much attached to these scenes.

III—The Lower Valley

And now, let's go farther down the valley until we come to that historic place called Champoeg, the site of the first governmental organization for this Oregon Country.

Schafer, in his *History of the Pacific Northwest*, describes this dramatic meeting in these words:

"There was much uncertainty in the minds of the settlers as they gathered at Champoeg on the second of May. The committee, however, reported in favour of establishing a government. When a motion was made to adopt this report, the vote was very close, and some one called for a division of the house. At this point arose the stalwart figure of "Joe" Meek, one of the most picturesque of the "mountain men", and a person of considerable influence among certain classes in the community. Stepping out grandly in front of the crowd of excited men he shouted: "Who's for a divide? All in favour of the report and of an organization, follow me." The count was made, we are told, after half an hour of the greatest confusion, and resulted in fifty-two (52) votes in favor and of fifty (50) against the resolution. So the project to organize a provisional government was carried."

There are times of great pioneer celebrations when one can visit this famous site in company with thousands of fellow citizens and listen to much oratory, but I preferred to visit it alone or with my own family. At such a time one can sit quietly and contemplate the lovely scene, undistracted by noise and chatter.

Sitting under the trees beside the river, one can at such times hear again the voices of the long departed pioneers as they decided upon their own political destiny. It is very essential that at intervals, in our busy, modern life, we pause and listen to these voices out of the past, and take

some serious thought for our own future political action, but always in the light of the experience of those who have blazed the trails before us.

Very appropriate to the time and place and what transpired then in the long ago, patriotic women have caused to be erected a complete replica of an old time log cabin with old fashioned rope and bucket well, rail fence, etc. Not many such can the city-dweller see today. There are still a few far back in mountain recesses off the auto roads, in mining camps and other places where primitive conditions still prevail. Were I a poet, instead of just another one of those matter-of-fact geologists, I would indulge in fitting verse to describe Champoeg and its memorials, but will have to leave that to others.

In this all-too-brief descriptive chapter, I have tried to give at least a suggestion of the Willamette valley scene by way of contrast to the more spectacular mountains, lakes and seascapes, because we are apt to overlook the beauty right at our own door and be a little contemptuous at times of the more commonplace in our immediate environment.

The Willamette Valley is one of the world's potentially richest valleys and one of the very desirable habitations of men. This statement is made advisedly and with first-hand knowledge of many valleys in many lands all over the globe.

Geologically, I might describe it as a valley in part structural, in part due to erosion by a stream working for the most part in Tertiary sediments, chiefly sandstones and shales, which dip, generally, in an easterly direction at low angles. The Willamette River is, for the most part, in an old age stage, marked by great meandering curves working back from the great Columbia. This north-flowing stream has captured successively from north to the south, a series of streams which probably all once flowed

to the westward. The upper valley is quite flat-floored, in marked contrast to the terrain farther down the stream, where Tertiary lava flows and igneous dikes have yielded less easily to erosion. Along the sides and notably at the upper end of the valley are monadnocks, or buttes, of more resistant rock.

Due to the natural levees along the banks of the main stream, the smaller tributaries have been forced to meander about on the broad flood plain (like the Long Tom and the Muddy) causing the development of much low swampy ground. These streams are called yazoo* streams. They are a vital factor in flood control. Bordering the sides of the valley and up the tributary valleys, one encounters from one to five terraces or benches which represent former higher levels of the streams. In places, the valley alluvial fill is as much as 250 feet thick, which is in itself quite a reservoir of water.

Whether or not you understand all of the above, you will never tire of the Willamette scene, and I invite you to look at it some time from the river vantage points I have chosen, the upper valley from Spencer's Butte, the middle valley from the red Waldo Hills, and the lower valley from the historic site of Champoeg, and I think you will agree with me that here is a land of quiet beauty, and one almost literally "flowing with milk and honey".

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*From the Yazoo, a tributary of the lower Mississippi.

Chapter XXIII.

HINTS TO TRAVELLERS

IT IS the custom among geographers to prepare handbooks giving the prospective traveller authentic and reliable information with regard to conditions of travel and work in various parts of the world. In this chapter we do not intend to go into the subject elaborately, but we shall throw out a few hints which may be useful to those who are proposing to make a tour through our state. The following suggestions are by no means complete and are stated in rather abbreviated form with the expectation that the reader and the traveller will consult various organizations within the state such as those mentioned in the next chapter, which will be glad to give more detailed information regarding many of these points.

At the outset the prospective tourist or traveller in Oregon should consult the tourist division of the State Highway Commission for general information, which inquiry will be passed on to other organizations to supply particular information which may be needed.

Second, one should get as authoritative literature as may be available and this can generally be supplied him more quickly from one of the departments at the State College and the University, or the State Department of Geology and Mineral Industries. Certainly anyone of a scientific turn of mind who wishes to make detailed scientific studies should contact these institutions first. For the general tourist the Oregon Motor Association next to the

State Highway Commission is perhaps the best prepared to serve him.

Third, the best time for travel in Oregon would be in the early summer, or after the early rains in September. During the latter part of the summer much of the fine scenery of the state is obscured by the ever-increasing smoke nuisance.

Fourth, one can find excellent accommodations throughout the state, with the possible exception of the extreme southeast corner in the region of the Steens Mountain. Even there, owing to the excellent road system, one can easily tour this part of the state and get to adequate, though not luxurious, hotel accommodations without too great a journey.

Fifth, some of the most striking beauty in the state can only be seen off the main highways and to see these one should be prepared to do a little hiking along the many Forest Service trails with a pack on his back.

Sixth, a complete camping equipment of all kinds may be secured at a number of cities such as Portland, Eugene, Bend, Klamath Falls, Medford, etc. So one does not have to lug a lot of camping equipment across the continent.

Seventh, before leaving the state one should at least see the following: Crater Lake, the Columbia Highway and Gorge, the Oregon coast, Wallowa Lake, and the Rift-Valley lakes of Central Oregon. These are some of the features that have no equal anywhere else in the United States. Of course there are many other striking features in the state but these at least should be covered.

Eighth, do not be in a hurry. Many tourists are simply on their way and see very little.

Ninth, if one wishes to prolong his stay in the state he can amplify his program by taking some excellent fishing trips. Some of the best hunting and fishing grounds in the

entire United States are to be found in the state of Oregon.

Tenth, wherever you go and at all times watch your campfires. The largest body of commercial timber standing in the United States is to be found in the states of Oregon and Washington. Through inexcusable carelessness on the part of some travellers, and also residents of this state, great areas of this magnificent forest have been laid waste. The first thing to do in coming into the state after contacting the Highway Commission and the Oregon Motorist Association is to get in touch with the nearest forest officials and get instructions and fire permits from them. If you do this early it may save you a lot of inconvenience and the state a lot of valuable timber.

By applying a little intelligent study with the help of the many organizations named in the next chapter one can make his vacation both profitable and pleasurable. On behalf of the great state of Oregon and its hospitable people we welcome you to one of the outstanding natural playgrounds of America. Having seen this magnificent wonderland, we feel sure you will want to return to it again and again.

Chapter XXIV.

OUT-OF-DOOR ORGANIZATIONS IN OREGON

THE following organizations have been interested in the Oregon outdoors, some for many years, while others have only lately been created. Some of them are directly concerned with the study of Oregon geology and scenery, while others are only indirectly interested, but their work has been of such nature that it has greatly aided the public in getting about over the state and enjoying these things. The organizations primarily concerned with the geology and scenery of the state are: The State Department of Geology and Mineral Industries, headquarters in Portland, the department of geology at the State College and University of Oregon, the Geological Society of the Oregon Country with headquarters in Portland, and the United States Geological Survey. Then there are such mountaineering organizations as the Mazamas, Portland; the Obsidians, Eugene; the Crag Rats, Hood River; the Trail Club, Portland; and the Bend Sky-liners (primarily a ski club).

In a third group there are the Forest Service, the National Park Association, the State Highway Commission of Oregon, the Oregon Motor Association, the Society for the Preservation of Roadside Beauty, the Coast Highway Association, and the Pacific Highway Association. There may be other organizations which are directly or indirectly fostering the study and appreciation of Oregon scenery on

the part of the public, but this is the list as we have it at the present time.

It is proper at this time to make some further comments concerning the work of each of these organizations. The first department of geology to be established in the state was at the state university under the pioneer geologist of the Oregon country, the late Thomas Condon, who came to the state as a congregational missionary in the very early days. This man more than any other single person in the state has been responsible for our present knowledge and great interest on the part of the public in the geology and scenery of this state. The two departments in the college and university have, besides giving many lectures to the general public, some of a popular nature, and some more strictly scientific, carried on various pieces of research work, and these have continued to keep the public informed of interesting things in this field.

The largest outside group at the present time fostering work of this nature is the Geological Society of the Oregon Country, founded in 1934 by Dr. E. T. Hodge, now professor of geology at the State College, Corvallis. This is an amateur organization which conducts caravans over the state and sponsors lectures at stated intervals for the benefit of members of the society and the interested public. It is doing a very noteworthy work in this field.

Perhaps the largest amateur organization is the Oregon Agate and Mineral Society, founded in 1932 by Dr. H. C. Dake, Portland dentist. This society now has several hundred members and publishes a magazine, the *Mineralogist*, with the largest circulation of any magazine of its kind in the country, perhaps in the world. This society also conducts caravans about the state and sponsors regular lectures, discussion groups, and exhibits.

The Mazama Mountain Climbing Club is one of the

oldest in the Northwest. It was founded July 19, 1894, and at the present time has several hundred members. Its headquarters are in Portland. While this society is primarily devoted in its activities to mountaineering, it has sponsored some geological studies and has published a number of pamphlets and special articles covering its work. Several years ago it began a series of illustrated pamphlets entitled *Oregon Out of Doors*. Two of these were issued, one on Mount Hood, and the other on Crater Lake. Owing to financial reasons the series was discontinued. It publishes an annual printed volume containing many interesting articles.

The Obsidians of Eugene was founded in 1927 and has over a hundred members. For the most part this club has confined its activities to mountain climbing, but has recently taken up a serious study of the Collier Glacier in the Three Sisters area.

The Crag Rats of Hood River is a group primarily devoted to mountain climbing. Its most spectacular work has been the rescue of persons lost in the mountains.

The Oregon Motor Association, with headquarters in Portland, was founded in 1905 and has several thousand members. This organization publishes monthly a magazine which from time to time contains interesting articles on the geology and scenery of the state, and has issued occasionally some interesting motorlogues which have added greatly to the pleasure of the motorist as he drives over the state.

The State Highway Commission through the building of the magnificent highways of the state has been of very great assistance to the general public. This is a very fine contribution to the understanding and enjoyment of the Oregon outdoors.

At present we have, in Oregon, fifty-seven state parks

and state monuments. In addition it has acquired other areas which have not yet been given official designation according to the latest list compiled by the National Park Service, Department of the Interior. The official list furnished by the State Highway Commission is given in Appendix B. These places of scenic and natural beauty are now being studied by the National Park Service in cooperation with state officials so that the main features of geological and biological interest may be presented to the public in the best possible manner. We have indeed a wonderful group of such areas. In addition to the state parks and monuments, there is one National Park, Crater Lake, and one National Monument, the Oregon Caves. It is to be hoped that the state parks will eventually be popularized for the benefit of the general public in the same effective way as the government has done in the case of Crater Lake and the Oregon Caves. The program of the National Park Service in Oregon is to be commended from every standpoint, but especially from the standpoint of its educational features. The program at Crater Lake is probably the most advanced of any in the country in one aspect at least, namely in the attempt to bring out the aesthetic values in a great natural phemonenon like that of Crater Lake. Certainly we should not be content with merely a scientific or even a popular description of the natural history of such a region. We must also try to develop the aesthetic side of the subject as well, and this has been exceedingly well done at Crater Lake during the past few years in cooperation with the University of Oregon and the Carnegie Institution.

The Oregon Association for the Preservation of Roadside Beauty is a flourishing organization in the state which has been very active in late years in a campaign to do away with some of the eye-sores along our highways and par-

ticularly in the neighborhood of great scenic attractions. The work of this association is to be most highly commended. Much yet remains to be done but the work will be slow, as it is difficult to make some people realize that they must forego some advantages through advertising if we are to preserve and exhibit our natural scenery to the best advantage. If the advertising man knew the angry reaction to his advertising on the highways on the part of the intelligent tourist he would soon get rid of his signs. This practice of littering up the country with billboards has nothing to commend it.

Both the Boy and Girl Scouts are interested in the out-of-doors, but as yet their programs in nature work are limited in scope. Plans for expanding in this direction among the older boys and girls are under consideration.

One very important organization is at this writing still lacking in the Oregon recreational picture, namely the Youth Hostels of America.* It is hoped that this great progressive movement which has long played such an important role in the upbuilding of youth and in the enjoyment of scenery abroad will soon take hold of the imagination of the people of the Pacific Northwest and especially find a warm response among the citizens of Oregon. When all is said and done, and in spite of the great part the automobile has played in bringing the great out-of-doors closer to the people, there is no finer way to enjoy scenery than with a pack on one's back and good old shank's mare or a bicycle for transportation.

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*A beginning has just been made, with one or two routes laid out.

Appendices

Appendix A

SOME OF THE MORE IMPORTANT POPULAR BOOKS AND ARTICLES ON OREGON GEOLOGY AND SCENERY

A Native Son's Rambles in Oregon
Amos Burg
National Geographic Magazine. Vol. 65. Jan.-June, 1934

Columbia River Gorge
Ira Williams
Oregon Bureau of Mines and Geology, Mineral Resources of Oregon. No. 3. Nov., 1916

Crater Lake
J. S. Diller
National Geographic Magazine. Vol. 8, 1897

Crater Lake
J. S. Diller
Pt. 2 of Oregon Out of Doors Magazine. 1922

Crater Lake; The Enchanted Lake
S. C. Lapham. The Statesman Pub. Co., Salem, Ore., 1931

Crater Lake—A Study in the Appreciation of Nature
John C. Merriam
American Magazine of Art. Vol. 26. No. 8. Aug., 1933

Crater Lake
W. W. Atwood
National Geographic Magazine. March, 1937

Geological Society of the Oregon Country Bulletins contain many valuable articles for the laymen. Portland, Oregon

Glaciers of Mt. Jefferson
Laura Hatch
Mazama: A Record of Mountaineering. Vol. 5, No. 2. Dec., 1917

GLACIERS OF NORTH AMERICA
I. C. Russell
Ginn & Co., 1897

GLACIERS OF THE THREE SISTERS
Ira A. Williams
Mazama: A Record of Mountaineering. Vol. 5. Dec., 1916

GUARDIANS OF THE COLUMBIA
John H. Williams. 1912

GUIDEBOOK OF THE WESTERN UNITED STATES
Pt. D. The Shasta Routes and Coast Line
J. S. Diller et al
U. S. Geol. Survey Bull. 614. Wash., 1915

LAKES OF NORTH AMERICA
I. C. Russell
Ginn & Company. 1904

LAVA RIVER TUNNELS
Ira Williams
Natural History. Vol. 23. March, April, 1923

LIFE OF A FOSSIL HUNTER
Charles Sternberg
H. Holt & Co., 1909

Mazama Magazine—many articles on Mountaineering and Scenery
Portland, Oregon

MOUNTAINEERING IN OREGON
Francis F. Victor
Overland Monthly. Vol. 1, 1880.

MOUNTAINS OF OREGON
William G. Steele
Oregon Bibliography, Portland, 1890

MOUNT HOOD
I. A. Williams
Oregon Out of Doors, Mazamas, 1920

MOUNT JEFFERSON
Ira Williams
Mazama: Vol. 5, 1917

MOUNT MULTNOMAH—Ancient Ancestor of the Three Sisters
E. T. Hodge
University of Oregon, publication, Vol. 3, No. 2. August, 1925

MOUNT THIELSEN
Ira Williams
Natural History. Vol. 20. September, October, 1920

OREGON CAVES: Marble Halls of Oregon
Ira Williams
Natural History. Vol. 20. September, October, 1920

OREGON GEOGRAPHIC NAMES
Lewis A. McArthur
Portland, Oregon, 1928

OREGON GEOLOGY
Thomas Condon
Revisions of "The Two Islands". J. K. Gill & Co., 1910

OREGON'S OUTSTANDING GEOLOGICAL FEATURES
Warren D. Smith
Oregon Blue Book. 1933-34

PHYSICAL AND ECONOMIC GEOGRAPHY OF OREGON
Warren D. Smith et al.
State System of Higher Education. 1940.

PHYSIOGRAPHY OF THE OREGON COAST
Warren D. Smith
Pan-American Geologist. Vol. 59, 1933. Vol. XIX, Feb., March, April, May, 1933

RIVERS OF NORTH AMERICA
I. C. Russell
Putnam Company, 1898

SOME LITTLE-KNOWN SCENIC PLACES IN THE CASCADE RANGE, OREGON
Ira Williams
Oregon Bureau of Mines & Geology, Mineral Resources of Oregon
Vol. 2, No. 1. May, 1916

THE COLUMBIA HIGHWAY
M. C. George

THE TWO ISLANDS, AND WHAT BECAME OF THEM
Thomas Condon

J. K. Gill & Co., Portland, Oregon, 1902
(A review by N. H. Winchell, American Geologist. Vol. 36, August, 1905)

VOLCANOES OF NORTH AMERICA
I. C. Russell
MacMillan Co., New York, 1897

WALLOWA MOUNTAINS
Warren D. Smith
Mazama: Vol. 5, No. 3, 1929

For further titles and more technical articles consult Bibliography of the Geology and Mineral Resources of Oregon, R. C. Treasher and E. T. Hodge, Portland, 1936.

Appendix B

STATE PARKS*

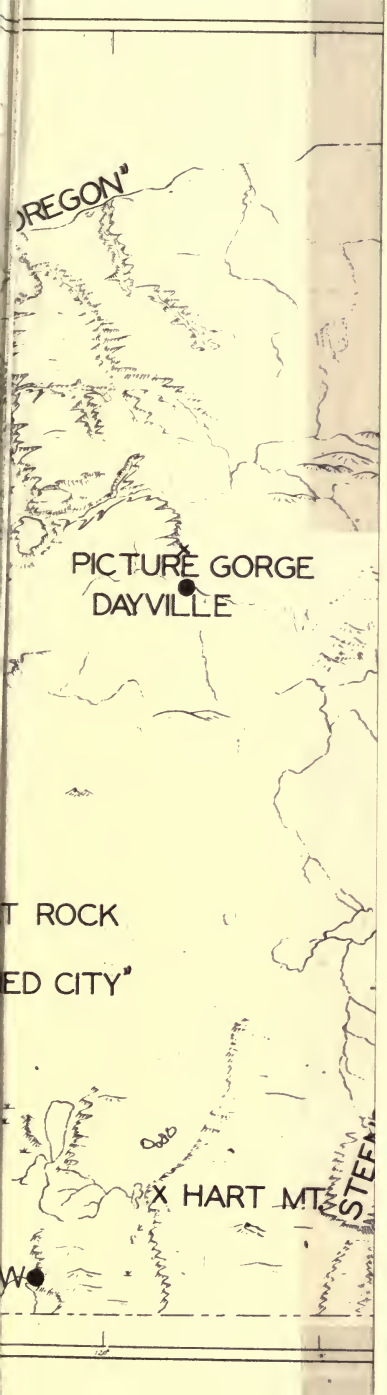
1. *Ainsworth Park*
2. *Alderwood Park*
3. *Alsea Bay Park*
4. *Apperson Park*
5. *Bald Peak Park*
6. *Battle Rock Park*
7. *Booth Park*
8. *Bradley Park*
9. *Boiler Bay Park*
10. *Buena Vista Park*
11. *Camas Mountain Park*
12. *Cape Arago Park*
13. *Cape Lookout Park*
14. *Cape Sebastian Park*
15. *Chandler Park*
16. *Devil's Elbow Park*
17. *Dyer Park*
18. *Ecola Park*
19. *Elkton Tunnel Park*
20. *Emigrant Park*
21. *Emigrant Hill Park*
22. *Gangloff Park*
23. *Geisel Monument Park*
24. *George W. Joseph Park*
25. *Glenada Park*
26. *Guy W. Talbot Park*
27. *Helmick Park*
28. *Holman Park*
29. *Humbug Mountain Park*
30. *Kellogg Park*
31. *Lang Park*
32. *Lava River Caves Park*
33. *Loon Lake Park*
34. *Mayer Park*
35. *McCord Creek Park*
36. *McKenzie Bridge Park*
37. *Memaloose Park*
38. *Mt. Hood Loop Park*
39. *Ochoco Park*
40. *Odell Park*
41. *Otter Crest Park*
42. *Peter Skene Ogden Park*
43. *Port Orford Cedar Park*
44. *Rhododendron Park*
45. *Rocky Creek Park*
46. *Saddle Mountain Park*
47. *Shelton Park*
48. *Sheridan Park*
49. *Short Sand Beach Park*
50. *Silver Creek Falls Park*
51. *South Bay Park*
52. *Starvation Point Park*
53. *Tongue Point Park*
54. *Torrence H. Foley Park*
55. *Umpqua Light House Park*
56. *Viento Park*
57. *Washburn Park*
58. *Woahink Lake Park*
59. *Wygant Park*
60. *Yachats Park*
61. *Yaquina Bay Park*
62. *Ziba Dimmick Park*

Crater Lake National Park

Oregon Caves National Monument

*The locations of these parks are indicated on the state highway maps which can be secured at most service stations.

ASTORIA
NEAHKAHNIE MT.
PORTLAND
"WHERE ROLLS THE
THE DALLES
MT. HOOD
CAPE LOOKOUT
CHAMPOEG
WALDO HILLS
SALEM
"JUMP-OFF JOE"
CORVALLIS
NEWPORT
STATE COLLEGE
GHOST FOREST
HECETA HEAD
SEA-LION CAVES
EUGENE
UNIVERSITY
THREE SISTERS
BEND
MARSHFIELD
"DEVIL'S WASHING MACHINE"
BANDON
SILVER LAKE
CRATER LAKE
MT. MAZAMA
PORT ORFORD
HUMBUG MT.
GRANTS PASS
MEDFORD
"MARBLE HALLS"
KLAMATH FALLS



(*Continued from front flap*)

So many persons have always found refreshment and enjoyment and information in Dr. Smith's book that Binfords & Mort have brought out this new printing for a still wider public.

The Author

Dr. Warren D. Smith, writer, scholar, noted teacher of earth science, is emeritus professor of geology and geography in the University of Oregon. A graduate of the University of Wisconsin and Stanford University, he came to the state in 1914.

Since then he has known Oregon first-hand with cumulative familiarity. He has seen it scientifically but through his own eyes. He has been over many miles of remote paths, and trails, and roads by foot and by car. He served as a consulting geologist for the Owyhee Dam and was for a period a ranger - naturalist in Crater Lake National Park.

The author of two other books, Dr. Smith also edited *Physical and Economic Geography of Oregon,* published by the state system of higher education. He has contributed extensively to newspapers, magazines, quarterlies, and reviews.

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